Final Environmental Impact Statement (Part 3 of 21)

Economics; Visual Quality; Air Quality; Noise; Energy; Public Services; Parks and Recreation

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4.4 ECONOMICS

This section describes the potential impacts of the Green Line on the economy of Seattle and the Puget Sound region, including the net economic benefits from improved travel time and reliability for transit users from the system, the employment and business income associated with the Project's construction, and potential impacts to the revenues of local governments. It also incorporates information presented in the Seattle Popular Transit Plan Programmatic EIS.

This section is prepared in compliance with the National Environmental Policy Act (NEPA). The State Environmental Policy Act (SEPA) requires analysis of employment impacts, but does not require economic analysis. However, Seattle's ordinance implementing SEPA includes economic impacts. The project's potential impact on population is discussed in Section 4.3, Land Use and Neighborhoods. A related analysis of business and housing displacements as well as other population impacts is contained in Section 4.2, Displacements and Relocation.

Construction of the Green Line, as approved by Seattle voters, will be financed by a local motor vehicle excise tax of 1.4 percent. Revenues from the motor vehicle excise tax would be used to back construction bonds that would be spent over approximately five years. A benefit-cost analysis of the Project indicates that the benefits will exceed the costs in total, present value terms. In addition, the five year construction of the Green Line (funded from future MVET) would result in an infusion of new money into the local economy that would generate demand for a variety of construction-related goods and services during the years of construction. The net transportation benefits and the economic activity during construction will both have a positive impact on tax revenues to state and local government. Finally, the construction of the Green Line will affect some local businesses within each Segment. This section describes these four categories of economic impacts: long-term travel benefits, regional employment and income during construction, incremental tax revenues to state and local governments, and localized impacts on business and employment.

4.4.1 Affected Environment

Since 1960, the Puget Sound economy has performed well compared to the overall growth of the U.S. economy.[1] The region currently has approximately 1.356 million workers (FDIC 2003), and its underlying economy has remained strong, with per capita wage rates for these workers high relative to national wage rates. Per capita income in King County was $46,494 in 2001 (PSRC 2003b), compared with $31,544 in Washington State as a whole and $29,884 for the United States (PSRC 2003b). Total employment income in the Seattle-Bellevue-Everett area in 2002 was $63.176 billion.

Despite its underlying strength, the economy has entered an economic downturn over the last few years, during which unemployment and personal bankruptcies have increased, job growth has slowed, and vacancy rates have risen (PSRC 2003b; FDIC 2003). Current economic conditions reflect this downturn. Unemployment in the Seattle-Bellevue-Everett area was 6.6 percent in April 2003, compared to 6.4 percent for King County, 7.3 percent for Washington State, and 6.0 percent for the United States (Washington State Employment Security 2003).

[1] This discussion of the affected environment is based on analysis prepared by the Puget Sound Regional Council (PSRC), the Federal Deposit Insurance Corporation (FDIC), and the real estate firm of CB Richard Ellis.

Forecasts of when the regional economy will return to pre-recession levels are cautious (PSRC 2003b). Estimates predict that the central Puget Sound region will experience very slow job growth in 2003 and may not fully recover to pre-recession growth rates until 2005. Unemployment rates may continue to increase due to an increased number of workers actively looking for jobs (PSRC 2003b). Job cuts in the aerospace and high tech sectors have increased unemployment rates in Seattle, Tacoma, and Vancouver. Current economic conditions reflect the struggle of the economy to recover with a weak labor market and continued loss of jobs.

4.4.1.1 Segment 1: Ballard Segment

Economic activity in the Ballard Segment consists of a mix of commercial and industrial activities. There are a number of retail chain stores, such as Safeway, QFC, Denny's, and Walgreens, as well as smaller restaurants (such as Quizno's and Wendy's), stores, and shops. The southern end of the segment has a high concentration of industrial activities and is a part of the Ballard Interbay Northend Manufacturing and Industrial Center (BINMIC) and the working waterfront along the Ship Canal. There is also an undeveloped site that is part of the Seattle Central Community College Maritime Training Center to the east of 15th Avenue NW. The businesses located within the Ballard Segment, as well as the other segments, are discussed further in Section 4.3, Land Use and Neighborhoods.

4.4.1.2 Segment 2: Interbay/Magnolia Segment

The Interbay Segment includes an urban industrial center with a mix of businesses in a commercial/manufacturing core. Maritime uses, light to heavy manufacturing, and warehousing characterize much of the land use along the segment. Economic activity in the Interbay area includes Fishermen's Terminal, dry docks, and boat repair facilities. Other businesses in the area include retail, services, and offices. The Interbay Athletic Complex (golf course and driving range) is also located along the Green Line alignment in the Interbay area. The potential site of the Interbay Operations Center alternative is located on a parcel of approximately 7.5 acres that is currently occupied by the Northwest Center.

4.4.1.3 Segment 3: Queen Anne/Seattle Center/Belltown Segment

The economic activities along the Queen Anne/Seattle Center/Belltown Segment include commercial, office, retail, high-density residential, and recreational enterprises. The Seattle Center is located along the Green Line alignment in this segment. The Seattle Center hosts many of the city's most important arts and cultural venues and it has a substantial number of business and organization clients operating within the Seattle Center campus, making it a unique economic activity area within the City of Seattle. The Belltown area is characterized by commercial office, retail, residential, and entertainment uses.

4.4.1.4 Segment 4: Downtown/Pioneer Square Segment

The Downtown Segment includes Seattle's central business district and is the economic center of the city and much of the Puget Sound region, with the highest concentration of employment in the state. The Downtown Urban Core and Seattle Commercial Core also comprise the highest concentration of retail and commercial activity areas in the city. Local, regional, and federal government offices are located along the Downtown Segment of the Green Line alignment.

4.4.1.5 Segment 5: SODO/Chinatown International District/Pioneer Square Segment

The SODO Segment includes the Pioneer Square and International Districts, as well as an industrial/ manufacturing district south to the Duwamish Waterway. The Burlington Northern Santa Fe (BNSF) Railroad tracks traverse the west side of SODO near the Alaskan Way Viaduct, and the region's primary

port and shipping facilities are located in the Port of Seattle terminal. Land use includes warehousing and distribution, railroads and terminal facilities, light manufacturing, parking, and mid-rise offices. There are also some retail, convenience store, and restaurant uses. The dominant facilities in the area are King Street Station, Union Station, the Seahawks Stadium, the Stadium Exhibition Center, Safeco Field, SODO Center, and the Seattle Public Schools administration building (the John Stanford Center for Educational Excellence).

4.4.1.6 Segment 6: West Seattle Segment

West Seattle is a largely residential area in the southwest quadrant of Seattle, and much of the economic activity of the area is generated within retail business centers at Alaska Junction and Morgan Junction. Industrial and manufacturing activity is concentrated in the Port of Seattle and the Duwamish Waterway manufacturing area located by the West Seattle Bridge. The other dominant industrial use along the West Seattle segment is the Nucor (formerly Birmingham) steel plant that occupies a 44-acre site south of the West Seattle Bridge.

4.4.2 Impacts

4.4.2.1 System-Level Impacts

Direct Economic Impacts

System-level impacts discussed below include long-term transportation benefits, changes to employment, labor and business income during construction, local tax revenues, and the localized impacts of property acquisition by segment on displaced businesses.

Transportation Benefits Relative to Costs

A study of the benefits and costs of the Green Line-demonstrated that the Project will generate annual benefits of $136 million (2002$) from travel time savings, parking cost savings, reduction in accidents, and improved reliability (http://archives.elevated.org/docs/BCA_Report_Final_revised.pdf). The monorail will generate annual travel time savings of approximately 5.5 million hours which are valued at half of the average regional wage rate resulting in annual benefits of $77 million. The reduced travel times and improved reliability of the monorail will induce some drivers to switch from cars to monorail and reduce their parking and auto operating costs. Together those savings are estimated at $40 million per year. Monorail trains traveling on an elevated guideways are more reliable and have lower accident rates that cars or buses traveling on congested roadways. The improved reliability and safety of the monorail will generate benefits of $19 million per year. These annual benefits are projected over the life of the project and compared to the costs of constructing and operating the system. The total benefits of the Project were estimated at $2.1 billion and when compared to estimated costs of $1.7 billion result in net benefits of $390 million (2002$). The Project was shown to generate net benefits across a reasonable range of assumptions regarding construction costs and future system usage.

Employment and Labor Income

Building the Green Line is expected to cost $1.75 billion (in year of expenditure dollars) and take five years to complete. Funding for construction and start-up operations will come from a Motor Vehicle Excise Tax (MVET) of up to 1.4 percent levied on certain vehicles registered in Seattle. After the Green Line becomes operational, fare box revenues would generate additional funds for operation and maintenance. Although all construction funds would be generated through local resources, these funds will be spent over a shorter period of time than they would normally have been (as tax revenues will be used to support construction bonds), providing a short-term infusion of new capital into the regional economy. By approving the Seattle Popular Monorail Plan, voters elected to purchase public transit

construction over five years instead of other goods and services over 30 or more years. Construction of the Green Line would therefore result in an incremental increase in employment and income by concentrating expenditures within the five years of construction. Some of the increased employment during construction would be offset by the shift in spending required to pay the 1.4% motor vehicle excise tax.

In addition to the direct construction jobs resulting from construction of the Green Line, construction spending is expected to generate 1,100 direct jobs per year in sectors offering direct services to the Project and additional 1,000 jobs from multiplier effects in other sectors of the local economy. These jobs would end shortly after construction is complete. Construction of the Green Line would generate a direct labor income from construction of $329 million. Construction employment and the resulting labor income have larger multiplier effects than other types of spending. The total labor income from the Project including multiplier effects (net of the effects from reduced spending due to MVET taxes) is projected to be $474 million (SMP 2003).

Construction of the Green Line would increase construction spending in the region during a time when the local economy is suffering from weak demand. Indirect impacts of increased output, employment, and personal income are anticipated to result from increased sales by sectors of the economy that support the direct purchases of supplies, materials, and labor associated with construction. Beneficial impacts result from increased sales to the employees of the directly and indirectly affected industries as they spend their earnings.

After construction, the Seattle Popular Monorail Plan projects that operation of the Green Line would require a staff of between 117 and 174 workers and a total annual labor budget of between $10.3 million and $14.4 million.

Revenues to State and Local Government

The economic activity associated with the construction of the Green Line could increase the revenues from sales and Business and Occupation (B&O) taxes levied by state and local governments. The Seattle Popular Monorail Plan anticipates paying $80 million in sales tax to state and local governments. In addition, all businesses involved in construction will pay B&O taxes totaling more than $10 million. These increases in tax revenues to the City of Seattle may be somewhat offset by reductions in revenues associated with business relocation and conversion of property from private to public ownership.

Some businesses subject to acquisition may choose to close or relocate outside Seattle city limits. The number of businesses that would decide to close or move outside the city is expected to be low, given the availability of suitable properties for relocation within Seattle. For those businesses that do close or relocate outside Seattle, there would be an associated loss of business and occupation taxes and property taxes, and potentially sales taxes. At the high end of the range, depending on the alignment and station alternatives selected, the Green Line would need to relocate 83 businesses along the alignment. If 10 to 20 percent decided to relocate outside Seattle or close, B&O, sales taxes, and property taxes could be lost for eight to eighteen businesses, resulting in a very small percentage reduction in total City B&O taxes, particularly since the tax revenues from individual businesses and properties potentially affected are apportioned to government agencies at City, County and State levels, and would not represent a substantial reduction in government receipts. Similarly, the loss of paid parking meters, although overall an important source of revenue to the City, remains limited in its economic effect given the overall supply of metered parking throughout the City, and would not result in a significant fiscal impact to the City.

The purchase of property by SMP would shift some real property from private to public ownership and thereby reduce the property tax revenues on those parcels. At most, depending on the alignment and station locations selected, the Green Line would require the purchase of 186 parcels that generate property taxes of between $2.0 and $2.17 million per year. In 2002, King County property taxes totaled

$1.6 billion for residential properties and $734 million for commercial properties (2002 King County Department of Assessments Annual Report). The greatest potential loss in property tax revenue to local governments from property purchase is approximately one-tenth of a percent (0.1%) of the total property tax revenue in the county. As discussed later in the section on indirect economic impacts, over the long term, private property values near stations tend to increase 10 to 40 percent relative to other similar properties. This increase in property values would tend to offset losses in tax revenue from SMP's purchase of private property.

Localized Impacts on Business and Employment

Depending upon which combination of stations and alignment alternatives is selected, the Green Line could affect between 22 and 83 businesses, organizations, or agencies that employ an estimated 1,274 to 483 to 1,636 workers. The estimate includes businesses that would be directly acquired because of a loss of function, which would include substantial loss of access for customers or the business's property access, or the removal of dedicated parking considered essential to the business. Information per segment is described below, and more detailed information about business and job displacements is found in Table 4.4-1. Estimates of employees that could be displaced were made based on business usage and square footage using methodology that was determined to be appropriately conservative for this analysis.

During public scoping, comments indicated concerns that the presence of the Green Line would decrease local economic activity for businesses along the alignment because of loss of visibility for passersby, or the loss of access, parking, or increase noise, traffic, congestion, visual impacts or other factors. These characteristics were considered in the analysis of indirect economic impacts, Section 4.4.

Because of the high residential, commercial, and industrial vacancy rates that currently exist and with similar availability projected for several years, SMP expects to be able to relocate most businesses and residents as needed with minimal adverse impacts (CB Richard Ellis 2003a,b,c). Most relocations are expected to be accommodated within Seattle, avoiding long-term losses in sales and B&O tax revenue to the City of Seattle and county and state government entities. However, successful relocations may be difficult for some businesses that have special needs, such as specific zoning requirements or access to types of customers, such as water-dependent or water-related uses. Also, some business owners may choose to close the business instead of relocating, and individual employees are not protected from the loss of jobs. A few businesses may choose to either close or relocate outside the City, thus negatively affecting local tax revenues.

Segment 1: Ballard Segment

As shown in Table 4.4-1, impacts to commercial enterprises along the Ballard Segment would occur only for Alternative 1.1 (West Side of 15th) or 1.1(s) (West Side of 15th single beam) stations. Alternative 1.1 could require relocation of 8 to 15 businesses that employ between 52 and 93 workers. The businesses potentially affected by this alternative include retail, commercial, and fast food establishments, as well as a boat repair business. Construction of Alternative 1.2 (Center of 15th) would not displace any business or public enterprise.

The Preferred Alternative, a single beam configuration along the west side of 15th Avenue NW, would require the relocation of 13 to 14 employers with an estimated 96 employees.

Segment 2: Interbay/Magnolia Segment

Construction of the stations for Interbay Segment Alternative 2.1 (West Side of 15th/Center of Elliott) would require displacement of two to five businesses and an estimated 23 to 123 workers. Businesses in this area include retail/restaurant, commercial, and industrial establishments.

Construction of the stations for Interbay Alternative 2.2 (Center of 15th/West Side of Elliott) would require displacement of six businesses with an estimated 53 to 79 workers.

Construction of Alternative 2.1 with either a west bridge (2.1.1) or far west (2.1.2) bridge connection would result in a partial acquisition of Port of Seattle property that includes industrial and water access dependent business activities. Under Alternative 2.1.1 (West Bridge Connection), a ship repair business could need to be relocated. Given the limited supply of waterfront space and related siting constraints, relocating these activities and workers would be difficult. The City of Seattle and other comments have emphasized the value of retaining maritime industrial operations in this area. While the displacement of the business would not alter the viability of other maritime industrial operations, the displacement of the business and its employees, if it could not be relocated to another suitable property in the area, would be a significant adverse impact. For more information, please see Section 4.3, Land Use.

Construction of the Operations Center in the Interbay Segment, which has been identified as the Preferred Alternative, would displace the Northwest Center (a community services center on two parcels) that houses eight operational enterprises (one employer) with an estimated 187 on-site workers. There are also clients in training served by Northwest Center, of which approximately 38 are off-site and 143 are on-site. Northwest Center (as of early July 2003) has a total of 330 employees and clients on-site. Businesses on this site include firms that engage in document destruction, document microfilming, assembly and packaging, commercial laundry, janitorial and grounds maintenance, and small manufacturing. The Northwest Center uses the earned income from these businesses to support its nonprofit mission to "promote the growth, development, and independence of persons with disabilities through programs of education, rehabilitation, and work opportunity." The Northwest Center provides services to over 500 people with disabilities each year. These parcels have a total of 266,500 square feet of office, industrial, and warehouse space (L. Pisconski, Northwest Center July 2003). Staff at the Northwest Center are currently investigating long-term options for the Center's location so that it can best serve its clients, in decisions independent of the Green Line project.

The Preferred Alternative for the Interbay Segment – Alternative 2.1 along the west side of 16th Avenue W and 15th Avenue W and the center of Elliott Avenue W would displace four business operations and an estimated 85 employees. This would include the boat repair facility at Fishermen's Terminal. The Interbay Operations Center, as noted above, would displace 8 operations and 187 on site workers.

Segment 3: Queen Anne/Seattle Center/Belltown Segment

In the Queen Anne/Seattle Center/Belltown Segment, Alternative 3.1 (Seattle Center/Republican) would require displacement of three to eleven businesses and an estimated 146 workers. This includes a mix of retail and commercial uses. It also includes a small portion of the Fun Forest at the Seattle Center where fewer than five rides could need to be relocated and one or two rides might be displaced. It is also assumed that the removal of the existing Seattle Center monorail structure would also involve the displacement of the business and the loss of employment for the operator's employees. While the operator would be eligible for compensation, relocation would not be possible.

Alternative 3.2 (Mercer) would require displacement of four to twelve businesses and an estimated 109 to 183 workers. Properties affected under Alternative 3.2 include a mix of retail and commercial uses. The existing monorail operations and employment would also be displaced as discussed for Alternative 3.1.

Alternative 3.3 (Thomas) would require displacement of eleven to fourteen businesses and 126 to 151 workers. Near Key Arena, the businesses displaced included the Sonics/Storm team shop. This alternative requires displacement of several businesses on Fifth Avenue, as well as surface parking lots in the area, and also includes displacing the existing monorail operations.

Alternative 3.5 (Second/Denny) would require displacement of 14 to 17 businesses and an estimated 116 to 142 workers. This alternative would affect the Spruce Building tenants and the Sonics/Storm souvenir shop near the Key Arena, as well as displacement of the existing monorail operations.

The Preferred Alternative for the Queen Anne/Seattle Center/Belltown Segment would displace four businesses and 61 employees. This includes a mix of retail and commercial uses, as described for Alternative 3.1, and small portion of the Fun Forest at the Seattle Center where fewer than five rides could need to be relocated and one or two rides might be displaced. SMP will strive to relocate the Fun Forest within the Seattle Center campus. The removal of the existing Seattle Center monorail structure would also involve the displacement of the business and the loss of employment for the operator's employees. While the operator would be eligible for compensation, relocation would not be possible.

Segment 4: Downtown Segment/Pioneer Square

Construction of Alternative 4.1 (West Side of Second) would require displacement of between 8 and 21 businesses and public entities that employ between 203 and 253 workers. Affected enterprises include a mix of retail and commercial uses, as well as the Federal Reserve Bank. Construction of the Fifth and Stewart 2 (Virginia) station (Alternatives 4.1 and 4.3) would include extending a pedestrian walkway to the Westlake Center. Given the increase in overall transit service ridership to the area to be provided by the Green Line, this option would be likely to maintain or increase the number of potential customers entering the Westlake Center and is therefore likely to increase economic activity in Westlake Center. In addition, the Center and its businesses would continue to be located within an urban area with considerable activity unrelated to the operation of the existing monorail. Patrons of the Westlake Center would continue to be able to access the center through a wide variety of means, just as they do today, including by the Downtown Seattle Transit Tunnel, surface transit, walking, bicycling or by private vehicle.

Alternative 4.2 (East Side of Second with Crossover) or Alternative 4.4 (East of Center of Second with Crossover) would require displacement of up to 10 businesses and an estimated 31 to 51 workers.

Alternative 4.3 (Center of Second) could require displacement of 21 businesses and public enterprises and an estimated 244 workers, including displacement of the Federal Reserve Bank for the proposed Madison 3 (Center) station.

The Preferred Alternative for the Downtown Segment (Alternative 4.1 along the west side of Second Avenue) would require displacement of 8 business and 228 employees, including the mix of retail and commercial uses described above for Alternative 4.1.

Segment 5: SODO/Chinatown International District/Pioneer Square Segment

None of the alternatives for the Weller/King or Safeco Field stations would require business displacements. Construction of the guideway alternatives would not directly displace any business or public enterprise, nor require the relocation of workers.

Construction of Alternative 5.1 (East Side of Third/Utah), Option 5.1.1 (Utah) with a Lander 1 (Northeast) station could displace four retail businesses and an estimated 54 workers. The Lander 4 (Utah) station could displace one business (Home Depot hardware store), and an estimated 196 to 300 employees. Under Option 5.1.2 (First Avenue S), loss of parking associated with the Home Depot could affect the store's ability to maintain a viable business at that location. The Lander 2 (Southwest) station associated with Alternative 5.1.2 would displace two businesses. As noted below in the discussion of the Operations Center, which also would displace the Home Depot, the City of Seattle as well as parties from the nearby area have indicated concerns about the loss of the Home Depot and its related tax revenues.

Construction of the Lander 3 (Diagonal) station for Alternative 5.2 or 5.2(s) (West Side of Third/Utah) would require displacement of five retail businesses that employ an estimated 38 workers.

If the Operations Center is located in the SODO area, it would require displacement of five businesses with an estimated 496 workers. Businesses on this site include industrial and retail activities, including Home Depot, Washington Chain Supply, Ederer Crane, All Metals Fabricators, and St. Vincent De Paul Society. Comments received, including from the City of Seattle, stated that the displacement of the Home Depot, a major employer and, as estimated by the City, a source of nearly $10 million in tax revenue annually. The City's comments stated that a business and employment displacement of this scale was undesirable, and would be a significant adverse impact.

The Preferred Alternative for the SODO segment (Alternative 5.2(s), a diagonal alignment with single beam portions along the west side of Third Avenue S and Utah Avenue S with no SODO Operations Center) would displace five businesses with an estimated 38 employees. Businesses on the site include industrial, manufacturing and retail operations.

Segment 6: West Seattle Segment

As shown in Table 4.4-1, Alternative 6.1 (West Seattle I) if constructed along the entire West Seattle Segment would require displacement of up to 11 businesses with an estimated total of 63 to 81 workers. Construction of Alternative 6.2 (West Seattle II) along the entire West Seattle Segment would require displacement of 3 to 4 businesses with an estimated 17 employees. Construction of any of the guideway alignments for the West Seattle Segment would not require any relocation of businesses or public enterprises. Subsegment Alternatives 6.3(s), 6.4 and 6.4(s) would require no business and employment displacements. Subsegment Alternative 6.5 would displace five businesses, with an estimated 16 employees.

Construction of a new, monorail-only bridge over the Duwamish River would take two years and could cause a minor disruption to Port of Seattle terminal activities during this time, but this would be minimized through coordination with the Port of Seattle during design and construction.

The Preferred Alternative for the West Seattle Segment (a combination of alignment alternatives that would feature a single beam crossing over the West Seattle Bridge, single beam configuration north of the Nucor steel plant above SW Spokane Street to SW Avalon Way, 35th Avenue SW, SW Alaska Street, 42nd Avenue SW, and then a single beam configuration along the west side of California Avenue SW) would displace four businesses and approximately 31 employees.

Table 4.4-1. Business and Employment Displacement Impacts by Segment

		Employers	Estimated No. of Employees
Ballard Segment			
TOTAL	**Alternative 1.1 - West Side of 15th**	**8-15**	**52-93**
Guideway	West Side 15th	--	--
Guideway	Alt. 1.1.1 West Bridge Option	1	4
Guideway	Alt. 1.1.2 Far West Bridge Option	--	--
Station	Crown Hill 1 (West, 85th)	7	25
Station	Crown Hill 1A (West)	4	20
Station	NW 65th 1 (West) and 1B	6	39
Station	NW 65th 1A	4	32
Station	NW Market 1 (Southwest)	--	--
Station	NW Market 3 (Northwest)	1	25
TOTAL	**Alternative 1.1 (s)**	**13**	**101**
Guideway	Single Beam Configuration	--	--
Station	Crown Hill 1A (West)	4	20
Station	NW 65th 1B (West)	6	39
Station	NW Market 3A (Northwest)	3	32
TOTAL	**Alternative 1.2 - Center of 15th**	**0**	**0**
Guideway	Center of 15th Option	--	--
Guideway	Center of 15th/East Bridge Option	--	--
Station	Crown Hill 2 (Center)	--	--
Station	NW 65th 2 (Center)	--	--
Station	NW Market 2 (Center)	--	--
TOTAL	**Ballard Preferred Alternative and 1.1(s)**	**13-14**	**96**
Guideway	West Side of 15th (single beam – 1.1(s))	--	--
Guideway	Alt. 1.1.1 West Bridge	0-1	5
Station	Crown Hill 1A (West)	4	20
Station	NW 65th 1B (West)	6	39
Station	NW Market 3A	3	32
Interbay Segment			
TOTAL	**Alternative 2.1 - West Side of 15th/Center of Elliott**	**2-5**	**23-123**
Guideway	West Side of 15th/Center of Elliott	--	--
Guideway	Alt. 2.1.1 -West Bridge Connection	1	22
Guideway	Alt. 2.1.2 -Far West Bridge Connection	--	--
Station	Dravus 1 (16th)	1	38
Station	Dravus 1A (16th)	1	10
Station	Dravus 1B	--	--
Station	Howe 1 (West)	1	--
Station	Howe 1A (Blaine)	2	40
Station	Elliott and Mercer 1 (Center)	1	23
Station	Elliott and Mercer 1A (Center)	1	23

Table 4.4-1. Business and Employment Displacement Impacts by Segment (continued)

		Employers	Estimated No. of Employees
TOTAL	**Alternative 2.1(s) - Center of 15th/West Side of Elliott**	**4**	**85**
Guideway	Single Beam Configuration	1	22
Station	Dravus 1B (Barrett)	--	--
Station	Howe 1A (Blaine)	2	40
Station	Elliott and Mercer 1A (Center)	1	23
TOTAL	**Alternative 2.2 - Center of 15th/West Side of Elliott**	**6**	**53-79**
Guideway	Elliott East Bridge Option	--	--
Station	Dravus 2 (15th)	5	48
Station	Howe 2 (Center)	1	5
Station	Prospect 3 (West)	1	31
Station	Elliott and Mercer 2 (West)	--	0
TOTAL	**Interbay Preferred Alternative**	**4**	**85**
Guideway	West Side of 15th/Center of Elliott (Alt 2.1)	--	--
Guideway	Alt. 2.1.1 West Bridge Connection	1	22
Station	Dravus 1-B (Barrett)	--	--
Station	Howe 1A (Blaine) -	2	40
Station	Elliott and Mercer 1A (Center)	1	23
TOTAL C-1 Operations Center (Preferred)		**8**	**187**
Queen Anne/Seattle Center/Belltown Segment			
TOTAL	**Alternative 3.1 - Seattle Center/Republican**	**3-11**	**68-146**
Guideway	Seattle Center/-NW Route	4	45
Guideway	Fifth Avenue N (Original East Side alignment)	3	60
Guideway	Fifth Avenue N (Revised center alignment)	--	--
Station	Seattle Center/Queen Anne 1 (North)	--	--
Station	Seattle Center/Queen Anne 1A (North)	--	--
Station	Seattle Center/Fifth and Broad 1 (Southeast)	4	60
Station	Seattle Center/Fifth and Broad 1A-	3	23
Station	Belltown 1 (Center-West)	3	26
Station	Belltown 1A (West)	1	12
Station	Belltown 2 (Center-East)	--	0
TOTAL	**Alternative 3.2 – Mercer**	**4-12**	**109-183**
Guideway	Harison	--	--
Guideway	Mercer to Fifth	3	87
Station	Seattle Center/Queen Anne 1 (North)	--	--
Station	Seattle Center/Fifth and Broad 1A	3	23
Station	Seattle Center/Fifth and Broad 2 (Harrison)	3	10
Station	Belltown 1 (Center-West)	3	26
Station	Belltown 1A (West)	1	12
Station	Belltown 3 (West)	6	73
TOTAL	**Alternative 3.3 – Thomas**	**11-14**	**126-151**
Guideway	Thomas	4	45
Station	Seattle Center/Queen Anne 2 (South)	3	20

Table 4.4-1. Business and Employment Displacement Impacts by Segment (continued)

		Employers	Estimated No. of Employees
Station	Seattle Center/Fifth and Broad 1 (Southeast)	4	60
Station	Belltown 1 (Center-West)	3	26
Station	Belltown 1A (West)	1	12
Station	Belltown 2 (Center-East)	--	1
TOTAL	**Alternative 3.5 - Second/Denny**	**14-17**	**117-142**
Guideway	Second/Denny	10	76
Station	Seattle Center/Queen Anne 2 (South)	3	20
Station	Denny 3	1	20
Station	Belltown 1 (Center-West)	3	26
Station	Belltown 1A (West)	1	12
Station	Belltown 2 (Center-East)	--	1
TOTAL	**QA/SC Preferred Alternative**	**4**	**61**
Guideway	Seattle Center/Republican	--	--
Guideway	Alt. 3.1 Northwest Route	--	26
Guideway	Alt 3.2 West of Center on Fifth	--	--
Station	Seattle Center/Queen Anne 1A (North)	--	--
Station	Seattle Center/Fifth and Broad 1A	3	23
Station	Belltown 1A (West)	1	12
Downtown Segment			
TOTAL	**Alternative 4.1 - West Side of Second**	**8-21**	**203-253**
Guideway	West Side of Second	--	--
	Alt. 4.1.2 -West Alignment Option B	--	--
Station	Fifth and Stewart 1 (Northwest)	9	40
Station	Fifth and Stewart 1A (West)	1	10
Station	Fifth and Stewart 2 (Virginia)	2	16
Station	Fifth and Stewart 2A (Virginia Center)	1	15
Station	Pike 1A (West)	10	20
Station	Pike 1B (West)	5	40
Station	Madison 1 (West)	1	172
Station	Yesler 1 (West)	1	1
TOTAL	**Alternative 4.2 - East Side of Second with Crossover**	**10**	**31-51**
Guideway	East Side of Second with Crossover	2	2
Station	Fifth and Stewart 3 (Lenora)	3	27
Station	Pike 2 (East)	1	1
Station	Madison 2 (East)	3	0-20
Station	Yesler 1 (West)	1	1
TOTAL	**Alternative 4.3 - Center of Second**	**21**	**244**
Guideway	Center of Second	7	14
Station	Fifth and Stewart 2 (Virginia)	2	10
Station	Pike 3 (Center)	10	40
Station	Madison 3 (Center)	1	172
Station	Yesler 2 (Center)	1	8

Table 4.4-1. Business and Employment Displacement Impacts by Segment (continued)

		Employers	Estimated No. of Employees
TOTAL	**Alternative 4.4 - East of Center of Second**	**9**	**49**
Guideway	East of Center of Second	1	--
Station	Fifth and Stewart 3 (Lenora)	3	27
Station	Pike 2A (East Center)	1	1
Station	Madison 2A (East Center)	3	0-20
Station	Yesler 1 (West)	1	1
Downtown Preferred Alternative		**8**	**228**
Guideway	Alt. 4.1		
Station	Fifth and Stewart 2A (Virginia Center)	1	15
Station	Pike 1A (West)	5	40
Station	Madison 1 (West)	1	172
Station	Yesler 1 (West)	1	1
SODO Segment			
TOTAL	**Alternative 5.1 - East Side of Third/Utah**	**1-4**	**20-392**
Guideway	East Side of Third/Utah	--	--
Guideway	Alt. 5.1.2 First Avenue S	0-2	0-196
Station	Weller/King Street 1 (Standard)	--	--
Station	Safeco Field 1	--	--
Station	Lander 1 (Northeast)	4	54
Station	Lander 2 (Southwest)	1	20
Station	Lander 4 (Utah)	0-1	0-196
TOTAL	**Alternative 5.2 - West Side of Third/Utah**	**5**	**38**
Guideway	West Side of Third/Utah	--	--
Station	Weller/King Street 2-(Event)	--	--
Station	Lander 3-(Diagonal) -	5	38
TOTAL	**Alternative 5.2 (s)**	**5**	**38**
Guideway	Single Beam configuration	--	--
Station	Weller/King Street Station 2	--	--
Station	Safeco Field 1	--	--
Station	Lander 3 (Diagonal)	5	133
TOTAL	**C-2 Operations Center**	**5**	**496**
TOTAL	**SODO Preferred Alternative**	**5**	**133**
Guideway	West Side of Third/Utah/5.2.2	--	--
Station	Weller/King Street 2- (Event)	--	--
Station	Safeco Field 1 with switch	--	--
Station	Lander 3- (Diagonal)	5	38
West Seattle Segment			
TOTAL	**Alternative 6.1 - West Seattle I**	**11**	**63-81**
Guideway	West Seattle Bridge	--	--
Guideway	Alt. 6.1.1 West Seattle Bridge/Past Pigeon Point	5	0-16
Guideway	Alt. 6.1.2 West Seattle Bridge/To Pigeon Point	--	--
Guideway	Alt. 6.1.3 West Seattle Bridge/Southeast Side of Fauntleroy	--	--
Guideway	Alt. 6.1.4 West Seattle Bridge/Northwest Side of Fauntleroy	--	--
Station	Delridge 1 (26th)	--	--

Table 4.4-1. Business and Employment Displacement Impacts by Segment (continued)

		Employers	Estimated No. of Employees
Station	Avalon 1 (Center)	3	45
Station	Alaska Junction 1 (42nd/Edmunds)	1	11
Station	Alaska Junction 1A (42nd/Edmunds)	1	9
Station	Morgan Junction 1 (West)	2	9
Station	Morgan Junction 1A (West)	2	9
TOTAL	**Alternative 6.2 – West Seattle II**	**3-4**	**17**
Guideway	New Bridge	--	7
Station	Delridge 2 (Andover)	--	--
Station	Avalon 2A (35th) and 6.2.1 Alignment	1	--
Station	Avalon 2B (35th) and 6.2.2 Alignment	2	--
Station	Alaska Junction 2 (44th/California)	--	--
Station	Morgan Junction 2 (Center)	2	10
TOTAL	**Alternative 6.3(s) - Delridge- North Subsegment**	**0**	**0**
Guideway	Delridge- North Subsegment	--	--
Station	Delridge 3 (North of Nucor)	--	--
TOTAL	**Alternative 6.4 - -Andover/Yancy Subsegment (and 6.4(s) with no station)**	**0**	**0**
Station	Delridge 1A (Delridge/Andover)	--	--
TOTAL	**Alternative 6.5 - Genesee Subsegment**	**5**	**16**
Guideway	Genesee Subsegment	5	16
Station	Delridge 4 (Genesee)	--	--
TOTAL	**West Seattle Preferred Alternative**	**4**	**31**
	Delridge Guideway and Station	--	--
	Avalon Guideway and Station	1	10
	Alaska Guideway and Alaska Junction 1 (42nd/Edmonds)	1	12
	Morgan Junction 1A	2	9

4.4.2.2 Indirect Economic Impacts

Current economic conditions mean that the construction of the Green Line could have a positive overall impact on the local and regional economies. The project is anticipated to cost over $1 billion in construction and related funding over the next five years and to increase demand for construction-related goods and services. As this money is introduced into the local economy, much of it will continue to circulate and create job opportunities as workers spend money on goods and services and recipients again spend money on other goods and services. Operation of the Green Line could also encourage tourism spending by providing an additional tourist amenity and providing easy access to other areas of the city and other tourist attractions.

Operation of the Green Line would have positive effects on many nearby businesses by improving public transit and providing new transit options for workers and by bringing new customers to different areas of the city. The Green Line would increase the net capacity of the transportation system in the Seattle area, thereby enhancing the overall capacity to conduct business. The Green Line would reduce travel time for some trips and increase predictability of travel time. Economic benefits of the project also include improved access to other regional job centers and public transportation, which could improve the ability

of workers to access a higher number of employers and could lead to less transportation spending for families who can reduce their dependence on private automobiles.

The Green Line could lead to increased commercial, industrial, and residential development within walking distance of the stations. However, the system could also interfere with views, decrease visibility of businesses, decrease parking, increase congestion, and restrict access. As discussed in 4.3, Land Use and Neighborhoods, indirect impacts to employment could result from partial displacements that affect parking supply, as well as losses in on-street parking that could result in reduced business activity. In addition, nearby businesses could be affected, either negatively or positively, as the guideway or station changes the community characteristics of the area.

A review of the literature regarding the effect of transit systems, including the existing Seattle Center Monorail and transit systems in other cities, finds that after construction is complete, the economic impact of transit, as reflected by property values, is generally favorable, although other local market factors continue to be the major driver for property values and economic utility. Property values are generally higher within one-quarter mile of transit stations, and a location premium often extends one-half mile from transit stations (Diaz 1999; RICS 2002; Interwest Property Services 2002; Cervero and Duncan 2002; SMP 2002a). As stated in Diaz 1999,

> "Residential properties become more attractive because residents near rail have more convenient access to regional employment, retail, and cultural opportunities. Properties holding employment uses such as offices and industrial sites experience higher property values because such properties have increased access to a larger labor market. In fact, office properties demonstrate a larger property value increase compared to industrial sites because office buildings tend to cluster in more dense concentrations, allowing for the benefit of rail to be more acutely felt. Finally, retail properties often benefit from the fact that rail transit contributes to the concentration of activity and increases in pedestrian traffic in transit-accessible, pedestrian-oriented districts."

Proximity to transit stations may not have a positive effect on property values where existing use of transit is low, or where transit stations are located in an area with heavy industry or close proximity of freeways to the rail tracks (Diaz 1999). An analysis of the Vancouver, British Columbia elevated SkyTrain light rail system found that "Generally, residential, commercial and office land values increase by 10 to 40 percent as a result of proximity to transit stations" (Interwest 2002).

Although very little of the literature on the effect of transit on economic activity addresses impacts between stations, that which does exist indicates that property values along transit lines are still higher than in surrounding communities, even between stations. Kenworthy and Newman (1992) found that while "freeways usually lower the value of much land along their routes, and disperse commercial developments to their ends... rail systems increase land values all along their routes, and concentrate commercial development (and compact housing) around stations." A study conducted by SMP found that compared with Second Avenue, the area of Fifth Avenue where the existing Seattle Center Monorail guideway is located has a greater percentage of higher-grade Class "A" commercial properties and that the rents for all property types were higher (SMP 2002a). The study found that, "The commercial properties along the existing monorail route do not appear to have suffered loss of revenue or value as a result of their locations along the guideway" (SMP 2002a).

4.4.2.3 No Action Alternative Impacts

Under the No Action Alternative, the Green Line would not be built and the 1.4 percent Motor Vehicle Excise Tax would not be collected. These funds would remain in the hands of the individual taxpayer to spend on other goods and services over the next approximately 30 years rather than being spent on Green Line construction and operations over the short term. Under the No Action Alternative, no properties

would be acquired, avoiding direct impacts to City and King County tax rolls, businesses, or employment. Positive benefits of the Green Line also would not occur.

4.4.3 Mitigation

In addition to the relocation policy described above in Section 4.2, Displacements and Relocation, the SMP design team would seek input from business owners regarding guideway height, alignment, station layout, streetscape, access, and parking to minimize adverse economic effects of possible impacts to businesses immediately adjacent to stations or the guideway. Potential mitigation measures could include designs that maintain visibility of businesses, signage, replacement parking, and marketing or promotional assistance programs for an initial start-up period.

4.4.4 Significant Unavoidable Adverse Impacts

There are not likely to be significant unavoidable adverse impacts to the local economy (including employment, income, tax revenue, and business activity) as a result of constructing or operating the Green Line.

4.5 VISUAL QUALITY AND AESTHETIC RESOURCES

This section describes the character of the existing landscape, the potential visual impacts of the alternatives, and potential mitigation measures. Mitigation measures include ways to avoid or minimize visual quality impacts and ways to restore or enhance visual quality. Visual quality assessment acquires and evaluates information about the existing conditions and visual resources of the proposed project area, the visual characteristics of the proposed facility(s), and the people who will view the facility. The City of Seattle Comprehensive Plan, Land Use Code, and State Environmental Policy Act (SEPA) policies were referenced to identify visual resources. The assessment methodology used here is adapted from the Federal Highway Administration's Visual Impact Assessment for Highway Projects (FHWA-HI-88-054) manual. The FHWA methodology was developed on behalf of communities adjacent to proposed transportation projects to give adequate consideration to the potential visual impacts resulting from highway projects. It has become an accepted framework for describing and analyzing the subjective visual experience and for developing the context for those analyses.

Although not required, the FHWA methodology was used for this EIS because the Green Line would be a linear transportation facility, like a highway, with a similar range of issues. Project impacts are evaluated with respect to the visual conditions that currently exist. Impacts are also considered for views of and from the Green Line. Impact is determined in terms of three critical factors:

- **Visual Quality** is the value assessment of the existing visual experience to the public, and the change in quality expected after the proposed project. The visual impact assessment describes the existing and proposed landscapes in terms of the memorability or distinctiveness of the landscape and whether the landscape is a harmonious mix of elements, free of eyesores or elements that do not fit with the overall landscape.
- **Viewer Response** is analyzed in terms of viewer exposure and viewer sensitivity, or the expectation a viewer would have for a visual experience in a given area. These two elements work together. *Viewer Exposure* refers to the physical location of viewer groups, the number of people exposed to a view, and the duration of their view. This includes both monorail and highway users and people in the surrounding area. *Viewer Sensitivity* is the degree to which a viewer expects a particular visual setting in an area based on the existing environment and extent to which visual elements are important to the viewer. Viewer sensitivity is affected by factors, such as the activities a viewer is engaged in; the visual context; and the values, expectations, and interests of a group of persons or a person involved in a particular activity or context.
- **Visual Character** is defined by existing visual resources and elements, and the relationships between them. These relationships are typically described in terms of dominance, scale, diversity, and continuity. Character-defining visual resources and elements include:
  - Landforms: types, gradients, and scale
  - Vegetation: types, size and maturity, and continuity
  - Land uses: size, scale, and character of associated buildings and ancillary site uses
  - Transportation facilities: types, sizes, scale, and directional orientation
  - Overhead utility structures and lighting: types, sizes, and scale
  - Open space: type (e.g., parks, reserves, greenbelts, and undeveloped land), extent, and continuity
  - Viewpoints and views to visual resources
  - Water bodies, historic structures, and Downtown skylines

- Apparent grain or texture, such as the size and alternation of structures and unbuilt properties or open spaces of the landscape
- Apparent upkeep and maintenance

The City of Seattle's SEPA environmental policies, in particular SMC 25.05.675.P, provide authority for the preservation of views of character-defining visual resources and elements from significant public viewpoints, parks, scenic routes, and view corridors. For this visual assessment, the viewpoints and significant views given in the SMC 25.05.675 that could be affected by the Green Line alternatives are listed in Table 4.5-1. Some SEPA viewpoints, such as Kinnear Park, Lawton Park and Playfield, Kobe Terrace Park, Jose Rizal Park, and Soundview Terrace Park are not included in this table because either the Green Line cannot be seen from the location or the Green Line is a distant view. Seattle code also provides authority to protect views of the Space Needle from nine locations identified by a combined inventory of SEPA sites and additional public places around Elliott Bay. Scenic routes designated in the SMC 25.05.675 that are in or near the Green Line route, or that could be visually affected by the alternatives, are listed in Table 4.5-2.

Table 4.5-1. Viewpoints and Public Views That Could Be Affected by Green Line Alternatives (per SMC 25.05.675.P.2.a)

Visual Resource	Direction of View
Mount Rainier	Southeast
Cascade Mountains	East
Olympic Mountains	West
Downtown Skyline	Varies
Puget Sound	Varies
Space Needle	Varies
Ship Canal	Varies
Viewpoint	
Betty Bowen Viewpoint, Queen Anne	West toward Puget Sound
Kerry Park	Southeast to Space Needle
Admiral/Belvedere Viewpoint	Northeast to City of Seattle skyline
Ballard High School	Southwest and west
West Seattle Stadium Park	West (Greenbelt) and East (Cascades)

Table 4.5-2. SEPA Scenic Routes (per SMC 25.05.675)

Scenic Route	Resource
Ballard Segment	
15th Avenue NW – S of NW Market Street to landfall at Interbay	Mt. Rainier, Ballard Bridge
Interbay/Magnolia Segment	
Magnolia Blvd W – W of 15th Avenue W	Elliott Bay
Elliott Avenue W - between Magnolia Boulevard and Pike Street	Elliott Bay, Puget Sound

Table 4.5-2. SEPA Scenic Routes (per SMC 25.05.675) (continued)

Scenic Route	Resource
Seattle Center/Queen Anne/Belltown Segment	
Mercer Street - between Queen Anne Avenue N and Fifth Avenue N	Seattle Center
Fifth Avenue - between Mercer Street and Stewart Street	Seattle Center, Seattle Skyline
Denny Way - between Elliott Avenue W and Broad Street	Puget Sound
Broad Street - between SR 99 and Denny Way	Puget Sound
Downtown/Pioneer Square Segment	
Yesler Way - Alaskan Way to Lake Washington Boulevard	Puget Sound, West Seattle
SODO/Chinatown International District/Pioneer Square Segment	
S Jackson Street - between Alaskan Way Viaduct and Rainier Avenue S	Mt. Rainier, Puget Sound
Alaskan Way Viaduct/SR 99	Puget Sound, Seattle Skyline, Olympics
West Seattle Segment	
35th Avenue SW	Seattle Skyline
SW Avalon Way	Seattle Skyline

4.5.1 Affected Environment

This section describes the existing visual context of the Green Line alternatives according to visual character, visual quality, and viewer response as defined above. This description is a four-step process: establish the visual limits, determine significant views to or from the project area, describe the visual context, and create simulations of the proposed facilities for the important views. This process establishes the baseline conditions and extent of the project's visual context. From this baseline, we can assess the potential change in visual resources due to the proposed project.

A tree inventory was performed to help define the project's visual context and get a rough estimate of how many trees were in the path of the alternatives. Trees along the proposed alternatives were counted, sized and identified, if possible, during site visits. All data are estimates since this was not a formal tree survey. Data for Seattle Center trees were provided by the Seattle Center and not the result of a physical inventory. Please refer to Appendix W from the DEIS for the inventory data. The approximate limits of the visual environment are defined by the geography and built and natural environments from which the project may be visible and vice versa. This area of reciprocal visibility is called a viewshed. The Green Line alternative alignments would pass through several viewshed areas with markedly different visual contexts. In open areas, such as the Ship Canal or through Interbay, the viewshed is the approximate extent of clear view. In built areas, such as Ballard, Belltown, or Downtown, the viewshed is a band two or three blocks wide centered on the alignment. Views may extend beyond the limits shown, but the viewshed diagrams are illustrative only and were simplified for graphical purposes. The viewsheds for the six segments of the Green Line are shown schematically in Figures 4.5-1 through 4.5-5 of the Draft EIS.

Based on the viewshed analysis, viewpoints were selected to illustrate views of the Green Line where substantial numbers of viewers and representative features of the proposed alternatives are present, and/or the visual quality of the view is high (Tables 4.5-3 and 4.5-4). Key views were identified through consultation with the City of Seattle, the State Historic Preservation Officer (SHPO) and Seattle Landmarks Board, and the Seattle Center. The selection process took Seattle's policies and regulations into account with regard to aesthetic and historic resources because there are cultural and historic resources throughout the 14-mile route.

Table 4.5-3. View Simulations - Appendix M (Appendix M is located in the Draft EIS)

Figure #	View Position	View	Resource	Station
Ballard				
M-1	15th Avenue NW to SE	West guideway Alternative 1.1		
M-2	NW 85th Street and 15th Ave NW to SW	Station; Alternative 1.1		Crown Hill 1 (West, 85th)
M-3	NW 65th Street and 15th Avenue NW to SW	Station; Alternative 1.1		NW 65th 1 (West)
M-4	NW Market Street and 15th Avenue NW to SE	Station; Alternative 1.1		NW Market 1 (Southwest)
M-5	NW Market Street and 15th Avenue NW to SW	Station; Alternative 1.1		NW Market 3 (Northwest)
M-6	NW 83rd Street and 15th Avenue NW to SE	Station; Alternative 1.2		Crown Hill 2 (Center)
M-7	NW 65th Street and 15th Avenue NW to SW	Station; Alternative 1.2		NW 65th 2 (Center)
M-8	NW Market Street and 15th Avenue NW to SW	Station; Alternative 1.2		NW Market 2 (Center)
Interbay/Magnolia				
M-9	Driving over the Ballard Bridge	North to Ballard with new box girder Green Line bridge to one side, Alternative 1.1.1 (West Bridge)	Ballard Bridge	
M-10	Fishermen's Terminal Memorial	Ballard Bridge and box girder Green Line bridge, Alternative 1.1.1 (West Bridge)	Ballard Bridge	
M-11	Fishermen's Terminal Memorial	Ballard Bridge and box girder Green Line bridge, Alternative 1.1.2 (Far West Bridge)	Ballard Bridge	
M-12	14th Avenue NW Boat Launch	Ballard Bridge and box girder Green Line bridge, Alternative 1.2 (East Bridge)	Ballard Bridge	
M-13	14th Avenue NW Boat Launch	Ballard Bridge and box girder Green Line bridge, Alternative 1.1.1 (West Bridge)	Ballard Bridge	
M-14	Fishermen's Terminal Memorial	Ballard Bridge and arched Green Line bridge, Alternative 1.1.1 (West Bridge)	Ballard Bridge	
M-15	Fishermen's Terminal Memorial	Ballard Bridge and cable-stayed Green Line bridge, Alternative 1.1.1 (West Bridge)	Ballard Bridge	

Table 4.5-3. View Simulations - Appendix M (Appendix M is located in the Draft EIS) (continued)

Figure #	View Position	View	Resource	Station
M-16	Elliott Avenue W and W Lee Street	Guideways; Alternative 2.1		
Interbay/Magnolia (continued)				
M-17	W Dravus Street	Station; Alternative 2.1		Dravus 1 (16th)
M-18	W Howe Street at 15th Avenue W	Station; Alternative 2.1		Howe 1 (West)
M-19	Elliott Avenue W at Sixth Avenue W	Station; Alternative 2.1		Elliott and Mercer 1 (Center)
M-20	W Bertona Street	Station; Alternative 2.2		Dravus 2 (15th)
M-21	Elliott Avenue W at W Republican Street	Station; Alternative 2.2		Elliott and Mercer 2 (West)
M-22	W Prospect Street and Elliott Avenue W	Station; Alternative 2.2		Prospect 3 (West)
M-23	Kerry Park	Elliott Avenue W guideways; Alternative 2.1		
Queen Anne/Seattle Center/Belltown				
M-24	W Harrison Street	Guideway along street; Alternative 3.1		
M-25	Sonics Shop to N	Station and guideway turning from W Harrison Street into Seattle Center; Alternative 3.1		Seattle Center/Queen Anne 1 (North)
M-26	Warren Street and Republican Street to E	Guideway; Alternative 3.1		
M-27	Middle of Founder's Court to S	Covered walkway along Republican Street, lawn and fountain area; Alternative 3.1		
M-28	Fisher Pavilion to N	Amphitheater, lawn and fountain, alley, Northwest Rooms; Alternative 3.1		
M-29	Near whale sculpture to NW	Enclosure of fountain room by guideway, tree border; Alternative 3.1		
M-30	Marion Oliver McCaw Hall café to SW	Bents, Copper beech and lawn; Alternative 3.1		
M-31	Kobe Bell to SE	Copper beech, curve into Memorial Stadium, alternative between south stands and Center House; Alternative 3.1		
M-32	Bagley Wright Theater lawn to SE	Guideway across lawn and fountain with Space Needle in background; Alternative 3.1		
M-33	Parking stall 50 for Bagley Wright to SSE	Guideway section and to lawn; Alternative 3.1		

Table 4.5-3. View Simulations - Appendix M (Appendix M is located in the Draft EIS) (continued)

Figure #	View Position	View	Resource	Station
M-34	Concrete steps on west side of EMP, E side of Fun Forest, to NW	Guideway elevation change, alternative through Center House and south bleachers; Alternative 3.1.1		
M-35	SE corner of Space Needle Plaza to SE	Connections to Seattle Center from station; Alternative 3.1		Seattle Center/Fifth and Broad 1 (Southeast)
Queen Anne/Seattle Center/Belltown (continued)				
M-36	Fifth Avenue near Vine Street to S along Fifth Avenue	Guideway down center of Fifth Avenue with city skyline in background; Alternative 3.1		
M-37	Cadillac/Teatro Zinzanni parking lot on Bell Street and Fifth Avenue	Station and profile; Alternative 3.1		Belltown 1 (Center-West)
M-38	Cadillac/Teatro Zinzanni parking lot on Bell Street and Fifth Avenue	Station and profile; Alternative 3.2		Belltown 2 (Center-East)
M-39	Third Avenue looking E along Mercer Street	Guideway; Alternative 3.2		
M-40	First Avenue and Mercer Street, to E	Bents and guideway; Alternative 3.2		
M-41	Middle of Founder's Court to N	Covered entry of Court and Mercer Street guideway; Alternative 3.1		
M-42	Outside lobby of Marion Oliver McCaw Hall to N	Alternative 3.2 - Mercer		
M-43	Just north of Thomas Street on Fifth Avenue to the north	Alternative 3.2 - Mercer		
M-44	Just S of EMP to NE	Station and Alternative 3.2 – Mercer		Seattle Center/Fifth and Broad 2 (Harrison)
M-45	South along Fifth Avenue from near Vine Street	Guideway axis down W side of Fifth Avenue with existing Seattle Center Monorail; Alternative 3.2		
M-46	Mid-block between Fifth Avenue and Sixth Avenue at Bell Street, to W	Station and profile; Alternative 3.1		Belltown 3 (West)
M-47	Key Arena Plaza, N end to S	Station at First Avenue and Thomas Street and guideway onto Thomas Street; Alternative 3.3		Seattle Center/Queen Anne 2 (South)
M-48	Just N of International Fountain to S	Lawn, fountain, and Fisher Pavilion; Alternative 3.3		
M-49	NW corner of Fisher Pavilion to SE	Children's Theatre; Alternative 3.3 -		

Table 4.5-3. View Simulations - Appendix M (Appendix M is located in the Draft EIS) (continued)

Figure #	View Position	View	Resource	Station
M-50	From just W of Fifth Avenue and Thomas Street entrance to W	Thomas alternative from EMP to Fun Forest Pavilion; Alternative 3.3		
M-51	E side of Space Needle Plaza to E	EMP entrance for monorail; Alternative 3.1.1		
M-52	Drop off on Denny Way by Pacific Science Center to SE	Station and Alternative 3.5 -		Denny 3
M-53	John Street and Second Avenue to N	Alternative 3.5 -		
Downtown/Pioneer Square				
M-54	Olive Street, Westlake Avenue, and Fifth Avenue to NW	Station, bents, historic buildings; Alternative 4.1	Times Square	Stewart and Fifth 1 (Northwest)
M-55	Second Avenue and Stewart Street to E	Historic buildings, guideway; Alternative 4.1	Sequoia, Josephinum	
M-56	Fourth Avenue, mid block between Stewart and Virginia Streets, toward Stewart Street	Historic buildings, profile of guideway; Alternative 4.1	Bon-Macy's, Mayflower Hotel, Times Square	
M-57	Virginia Street and Third Avenue to SE	Guideway profile, historic buildings; Alternative 4.1	Bon-Macy's, Securities Building	
M-58	Second Avenue near Union Street to N	Guideway and bents at Stewart Street and Second Avenue, historic buildings; Alternative 4.1	Josephinum	
M-59	Second Avenue near Stewart Street	Long view down Second Avenue to south, Alternative 4.1		
M-60	Same as 58	Same, Alternative 4.2		
M-61	Same as 58	Same, Alternative 4.3		
M-62	Pike Street and Third Avenue to W	Pike Place Market; Alternative 4.1	Pike Place Market sign	
M-63	Pine Street and Third Avenue to W	Pike Place Market; Alternative 4.1	Pike Place Market sign	
M-64	First Avenue and Cherry Street to E	Profile of guideway, historic buildings; Alternative 4.1	Hoge, Dexter Horton, Alaska Buildings	
M-65	Second Avenue and Marion Street, to NW	Bents crossing Marion Street, Madison 1 (West) station, guideway; Alternative 4.1	Federal Office Building	Madison 1 (West)
M-66	Yesler Way between Second and Third Avenues to W	Station; Alternative 4.1	Pioneer Square	Yesler 1 (West)
M-67	Second Avenue and Cherry Street to S	Station, guideway; Alternative 4.1		Yesler 1 (West)
M-68	Pike Street and Second Avenue to NE	Station, guideway; Alternative 4.2		Pike 2 (East)

Table 4.5-3. View Simulations - Appendix M (Appendix M is located in the Draft EIS) (continued)

Figure #	View Position	View	Resource	Station
M-69	Second Avenue and Marion Street to NE	Station, guideway; Alternative 4.2	Federal Office Building	Madison 2 (East)
M-70	Yesler Way and First Avenue, to E	Pioneer Square Pergola, station, base of Smith Tower; Alternative 4.3	Pioneer Square Pergola, base of Smith Tower	Yesler 2 (Center)
M-71	Second Avenue between Madison and Marion Streets, to NE	Station, guideway; Alternative 4.3	Federal Office Building	Madison 3 (Center)
M-72	S Washington Street between Occidental and Second Avenues S, to E	Guideway, historic buildings; Alternative 4.1		
Downtown/Pioneer Square (continued)				
M-73	Third Avenue and University Street, to W	Puget Sound, view corridor, profile of guideway, historic building, Seattle Art Museum and Benaroya Hall; Alternative 4.1	Puget Sound, Brooklyn Building	
M-74	Third Avenue and Spring Street, to W	Puget Sound, view corridor, guideway, station; Alternative 4.1	Puget Sound	Portion of Madison 2 (East)
M-75	Fourth Avenue and Marion Street, to W	Historic buildings on Second Avenue and Puget Sound in background; Alternative 4.1	Old Federal Building, Exchange Building, Puget Sound	
M-76	Fourth Avenue and Madison Avenue, to W	Puget Sound, view corridor, historic buildings, profile of guideway; Alternative 4.1	Puget Sound	
M-77	Fourth Avenue and Cherry Street, to W	Historic buildings on both sides of Cherry Street, Puget Sound; Alternative 4.1	Hoge, Dexter Horton, Alaska Buildings	
M-78	Fourth Avenue and Columbia Street, to W	Puget Sound, view corridor, guideway; Alternative 4.1	Puget Sound	
M-79	Fourth Avenue and Pike Street, to W	Pike Place Market sign; Alternative 4.1		
SODO/Chinatown International District/Pioneer Square				
M-80	Second Avenue Extension S, between S Main and S Washington Streets, to N	Alternative 4.1 - West Side of Second	Smith Tower	
M-81	Second Avenue Extension S and S Main Street, to S	Guideway; Alternative 4.1	King Street Station and other	

Table 4.5-3. View Simulations - Appendix M (Appendix M is located in the Draft EIS) (continued)

Figure #	View Position	View	Resource	Station
M-82	Yesler Way and Third Avenue, to S	Bents at Main Street, profile between King Street Station; Alternative 4.1	King Street Station	
M-83	Main Street and Fourth Avenue, to W	Guideway; Alternative 4.1	King Street Station and other	
M-84	S Jackson Street and Second Avenue, to E	Guideway; Alternative 4.1	Edge of King Street Station	
M-85	S Jackson Street and Fourth Avenue, looking W	Guideway; Alternative 4.1	King Street Station and other	
M-86	Seahawks Stadium parking lot, to NE	Guideway, Weller/King Station, elevated Second Avenue; Alternative 5.1	King Street Station	Weller/King Street 2 (Event)
M-87	Safeco Field	Station, guideway and overpass; Alternative 5.1		Safeco Field 1
M-88	S Lander Street and First Avenue S, to NW	Lander Station and guideway; Alternative 5.1		Lander 1 (Northeast)
M-89	S Lander Street and First Avenue S, to NW	Lander Station and guideway; Alternative 5.2		Lander 2 (Southwest)
SODO (continued)				
M-90	S Lander Street and Utah Avenue S, to S	Lander Station and guideway; Alternative 5.1		Lander 4 (Utah)
M-91	S Lander Street and Occidental Avenue S, to NW	Lander Station and guideway; Alternative 5.1		Lander 3 (Diagonal)
M-92	Beneath Alaskan Way Viaduct at S Hinds Street, to N	Flyover at Alaskan Way Viaduct looking N to city skyline; Alternative 5.1		
West Seattle				
M-93	Belvedere/Admiral Viewpoint, to SE	West Seattle Bridge and guideway; Alternative 6.2		
M-94	SW Andover Street between 26th and 28th Avenues SW, to SW	Station; Alternative 6.1		Delridge 1 (26th)
M-95	SW Avalon Way and SW Adams Street, to NE	Guideway, view of downtown Seattle; Alternative 6.1		
M-96	SW Avalon Way and Fauntleroy Way SW, to SE	Station and guideway: Alternative 6.1		Avalon 1 (Center)
M-97	42nd Avenue SW and SW Edmunds Street, to NW	Station and guideway; Alternative 6.1		Alaska Junction 1 (42nd/Edmunds)
M-98	California Avenue SW and SW Brandon Street, to S	Guideway; Alternative 6.1		

Table 4.5-3. View Simulations - Appendix M (Appendix M is located in the Draft EIS) (continued)

Figure #	View Position	View	Resource	Station
M-99	California Avenue SW and SW Morgan Street, to NW	Station and guideway; Alternative 6.1		Morgan Junction 1 (West)
M-100	Delridge Way SW and SW Andover Street, to W	Station; Alternative 6.2		Delridge 2 (Andover)
M-101	35th Avenue SW and SW Oregon Street, to SW	Station and guideway; Alternative 6.2		Avalon 2 (35th)
M-102	44th Avenue SW and SW Alaska Street, to SE	Station and guideway; Alternative 6.2		Alaska Junction 2 (44th/California)
M-103	California Avenue SW and Fauntleroy Way SW, to S	Station and tail tracks; Alternative 6.2		Morgan Junction 2 (Center)

Table 4.5-4. Updated View Simulations - Appendix MM (Appendix MM is located in this Final EIS)

Segment	Figure #	View position	View	Resource	Alignment	Station
Ballard						
	1	Looking south along 15th Avenue NW from NW 77th Street; same location as Figure M-1	Preferred Alternative*: Alternative 1.1 (s) single beam		1.1(s)	
	2	Looking south along 15th Avenue NW (east side) from NW 67th Street	Preferred Alternative: Alternative 1.1 (s); NW 65th 1B (West) station with dual beam passing area		1.1(s)	NW 65th 1B (West)
Interbay/Magnolia						
	3	Looking southeast along Elliott Avenue W toward Mercer Street from west side of Elliott Avenue W	Preferred Alternative: Alternative 2.1 and Elliott and Mercer 1A (Center) station and platforms over Elliott Avenue W		2.1	Elliott and Mercer 1A (Center)
	4	Looking south along 15th Avenue W from Dravus Bridge	Preferred Alternative: Alternative 2.1 and Dravus 1B (Barrett) diagonal station and dual beam guideways		2.1	Dravus 1B (Barrett)
Queen Anne/Seattle Center/Belltown						
	5	Looking south along Fifth Avenue at Broad Street from northeast corner of Fifth Avenue and Broad Street	Preferred Alternative: Alternative 3.1.4 and Seattle Center/5th & Broad 1A station and platforms		3.1, 3.1.4	Seattle Center/5th & Broad 1A (Southwest)

* Preferred Alternative is also the Final Staff Recommendation.

Table 4.5-4. Updated View Simulations - Appendix MM (Appendix MM is located in this Final EIS) (continued)

Segment	Figure #	View position	View	Resource	Alignment	Station
Downtown/Pioneer Square						
	6	Looking south along Second Avenue from Columbia Street	Preferred Alternative: Alternative 4.1; Yesler 1 station, vertical to horizontal transition of guideways at station		4.1	Yesler 1
	7	Looking south along Fifth Avenue from north of Virginia Street	Alternative 3.2; guideways and emergency walkway		3.2	Fifth and Stewart 2A (Virginia-Center)
	8	Looking north along Second Avenue (west side) from Marion Street; similar to Figure M-69	Alternative 4.4; Madison 2A (East of Center) station, guideway, and walkways over sidewalk		4.4	Madison 2A (East of Center)
SODO/Chinatown International District/Pioneer Square						
	9	Looking east toward King Street station from Seahawks Stadium parking lot	Preferred Alternative: Alternative 5.2 and King/Weller Street 2 (Event) station, platforms, and guideway	King Street Station	5.2	King/Weller Street 2A (Event)
	10	Looking southwest along First Avenue from northeast corner of First Avenue and Lander Street	Alternative 5.1; Lander 2 (Southwest) station, platforms, and guideway	Correction to Figure M-89: missing bent	5.1	Lander 2 (Southwest)
West Seattle						
	11	Looking north from Dragonfly Terraces toward SW Andover Street and Longfellow Creek Greenspace	Alternative 6.1; Delridge 1 (26th) station, guideways and Longfellow Creek and buffer	Longfellow Creek & buffer	6.1	Delridge 1 (26th)
	12	Looking northwest along California Avenue SW toward Dawson Street	Preferred Alternative: Alternative 6.1.6 (s) single to dual track transition		6.1.6(s)	
	13	Looking north along 35th Avenue SW from SW Alaska Street	Preferred Alternative: Alternative 6.2.2; Avalon 2B (35th) station and center guideway		6.2.2	Avalon 2A (35th)
	14	Looking west from Pigeon Point	Preferred Alternative: Alternative 6.3(s); Delridge 3 (Nucor) station and guideways		6.3(s)	Delridge 3 (Nucor)

Table 4.5-4. Updated View Simulations - Appendix MM (Appendix MM is located in this Final EIS) (continued)

Segment	Figure #	View position	View	Resource	Alignment	Station
	15	Looking northeast along SW Yancy Street, from near 28th Avenue SW	Alternative 6.4; Delridge 1A (Delridge/Andover) station, guideways and Longfellow Creek	Longfellow Creek Greenspace	6.4	Delridge 1A (Delridge / Andover)
	16	Looking southwest along Delridge Way SW, from SW Andover Street	Alternative 6.5; Delridge 4 (Genesee) station and guideways		6.5	Delridge 4 (Genesee)
	17	Looking east along Genesee Street from near 35th Avenue SW	Alternative 6.5 guideways	West Seattle Golf Course	6.5	

The criteria for determining visual impacts for Visual Quality and Aesthetics differ from those under Cultural Resources. Visual Quality and Aesthetics uses a gradient from low to high impacts to assess the entire context and activities within an area. The assessment is based on the synthesis of a set of broad criteria that include pedestrian or motorist experience, panoramic or scenic views, overall quality of the area, scale and contrast between elements in the area, and other factors. Cultural/Historic impacts evaluation is necessarily a narrower definition and focuses on whether or not the view of the historic resource has been affected. The Green Line's potential effect on historic resources, including changes to their visual setting, is evaluated in more detail in Section 4.11, Cultural Resources.

Photographs were taken from the viewpoints to be used for computer simulations that visualize different Green Line facilities, such as guideways and stations. While the simulations are limited in their field of view, the visual analysis considers the entire field of view. The photographs do, however, provide an accurate representation of the scale of a structure in relation to other objects seen from the viewpoint. Although station designs are prototypes, the simulations show the conservative case of unadorned, large-footprint and large-envelope station structures. These simulations depict the likely maximum footprint and height of the station, whereas in reality, stations may not be the maximum size. The views and simulations from the Draft EIS are in Appendix M (found in Volume Three of the Draft EIS document). This appendix also includes six conceptual visualizations that represent how specific alternatives may look after appropriate design features are included, including treatment of stations, guideways, and special structures, landscaping, and public art. These conceptual design simulations have been included alongside the related typical simulation.

Appendix MM was created in response to public comment on the Draft EIS. It presents seventeen simulations and a small portion of the urban design studies that were conducted as part of the community involvement and design development processes. SMP has undertaken an extensive urban design process in cooperation with the City and communities. Some of Seattle's leading designers were selected with community input to help visualize how the monorail can be woven into the existing urban fabric, and how stations' potential to enhance communities can be maximized.

In addition to its comprehensive urban design process, SMP has committed to a public art program of up to six million dollars, representing approximately one percent of construction costs, which will be administered by SMP, with the assistance of a public art consultant. SMP intends for the artists' work to be highly integrated into the system through design collaborations among contractor, engineers, architects and artists. SMP's intent is to concentrate its art effort in the guideways by involving the artists in the design development of the guideways and adjacent areas. In addition, other art opportunities will be developed and carried out through design and construction. Artists may be selected to collaborate on

system elements with the goals of improving the aesthetics of the entire system. Design collaborations will continue through the design process.

Sixteen of the simulations in Appendix MM are new and one is an update of Figure M-89 in Appendix M of the Draft EIS. The urban design study sections include on-going draft conceptual designs for stations and streetscapes; shadow studies for Second Avenue in the Downtown segment; and a comprehensive urban design study entitled "Draft Urban Design and Landscape Study: System-wide Urban Design and Landscape Guidelines". The City will use these draft guidelines as the basis to guide permitting of the Monorail. Appendix MM can be found in Volume Two of this Final EIS.

Segment 1: Ballard Segment

The topography in this segment includes a moderate southward slope consisting of the Crown Hill, Loyal Heights, and Whittier Heights neighborhoods and Ballard. At the base of this slope, a basin containing Salmon Bay and the Lake Washington Ship Canal separates Ballard from the north-facing slopes that comprise the Queen Anne and Lawton neighborhoods.

Urban development in the Ballard Segment is nearly continuous and consists of moderate-scale commercial development with parking areas along 15th Avenue NW and NW Market Street; warehouses, industrial buildings, and marinas along and near the waterfront; multifamily housing along arterials; and dense single-family neighborhoods to the east and west. At the south edge of this segment, the Ballard Bridge leads south to Interbay.

Vegetation in this segment consists primarily of street trees and minimal ornamental plantings in commercial areas. Open space is associated with Ballard High School, several elementary schools, and diverse residential plantings. Existing scale is moderate in commercial areas, moderate to large along the waterfront industrial area and around the larger retail buildings in the segment, and small in single-family neighborhoods. Views in this segment tend to be limited by the density of development, and are primarily to the south and east. Scenic views are available, including those of Mt. Rainier and neighboring Queen Anne, Phinney, and Magnolia Hills. The Ballard Bridge offers scenic views of the Olympics and the water-oriented development and activities along Salmon Bay and the Ship Canal. Limited views of the Olympic Mountains are available looking west along arterials, and the waterfront can be seen on some street ends.

SEPA viewpoints include Ballard High School, which has views from its south edge of Mt. Rainier, and Queen Anne and Magnolia Hills. 15th Avenue NW is a designated scenic route from NW Market Street to the south edge of the segment, including the Ballard Bridge. Views down 15th Avenue NW south of NW 65th Street are similar to those listed above for Ballard High School. Views from Ballard Bridge, a historic structure (see Section 4.11, Cultural Resources), consist of the Lake Washington Ship Canal to the east, Salmon Bay and the Olympic Mountains to the west, and surrounding waterfront development and activities.

Although scenic views are available in this segment, the aesthetic experience of pedestrians along the proposed Green Line alternative alignments in this segment is diminished by traffic, an abundance of parking lots, and the lack of landscape improvements typical in a vehicle-oriented environment. Additionally, commercial and transportation signage, signalization, street lighting, and overhead utilities create a moderate degree of visual clutter. As a result of these factors, viewer expectation in the segment is low to moderate.

Table 4.5-5 summarizes the major visual resources and viewers in the Ballard Segment.

Table 4.5-5. Existing Visual Resources – Ballard

Landscape Unit	Limits	Visual Character	Public Visual Resources
15th Avenue NW - Loyal Heights/ Whittier Heights	NW 87th Street to NW 67th Street	Terrain: gentle slopes Vegetation: street trees, some commercial and yards Buildings: low-rise commercial, some homes, condos, apartments Transportation structures: signals, roadway, bus stops Overhead structures: signals, utilities, roadway and commercial signage Open space: none Visual scale: medium	Mid-distant views of Magnolia, Queen Anne, Phinney Ridge
15th Avenue NW - Ballard	NW 67th Street to NW 50th Street	Terrain: gentle slopes Vegetation: street trees Buildings: low-rise and big-box commercial Transportation structures: signals, roadway, bus stops Overhead structures: signals, utilities, roadway and commercial signage Open space: none Visual scale: medium	Mt. Rainier Mid-distant views of Magnolia, Queen Anne, Phinney Ridge
Ballard Bridge	NW 50th Street to W Emerson Street	Terrain: gentle slopes, floodplain Vegetation: volunteer and invasives Buildings: light marine commercial and industrial Transportation structures: Ballard Bridge, drawspan roadway, onramps Overhead structures: drawspan structure, some utilities Open space: Salmon Bay Visual scale: medium to large	Viewpoint/Park: 14th Avenue NW Boat Ramp, Fishermen's Terminal Park/Historic: Ballard Bridge

"Historic" refers to resources that are either eligible or listed on national or local historic registers.

Segment 2: Interbay/Magnolia Segment

The terrain along the alternative alignments through this segment consists of the relatively flat trough in which the Interbay area is located. This area is bounded on the east by the steep slopes of Queen Anne and by the equally steep slopes of Magnolia to the west. Greenbelts cover much of these adjacent slopes. Other vegetation includes modest ornamental plantings, plantings in the Interbay P-Patch, and the broad lawn areas of the Interbay Athletic Complex (see also Section 4.10, Parks and Recreation).

Urban development in this segment is nearly continuous, but not dense, and ranges broadly from small- and medium-scale commercial, to multifamily housing, to large-scale office buildings, warehouses, and waterfront grain elevators. Limited areas of single-family housing can also be found in this segment. At the south end of this segment, overpasses for both the W Galer Street and Magnolia Bridges run perpendicular to the corridor, leading to development along and near Smith Cove and the Magnolia neighborhood.

Surface roads in this segment vary in width from two lanes in mixed commercial/single-family residential areas to seven lanes, including a turning lane, on 15th Avenue W. A Burlington Northern Santa Fe (BNSF) track parallels the corridor's west edge and serves the industrial uses near Elliott and Salmon

Bays and Smith Cove. Existing overhead facilities are numerous, including street overpasses, light standards, large-scale sign commercial structures, electric distribution lines that serve industrial uses in this segment, and associated utility poles. At the Interbay Athletic Complex, netting and metal poles associated with a driving range are prominent visual features.

Existing scale is large along the industrial waterfront and in areas with office and multifamily residence structures, moderate in areas with commercial uses, and small in the limited areas with single-family houses.

Recent development in this segment includes large office buildings and multifamily developments on the south end of this segment, and office development in the formerly industrial area on Smith Cove, between W Galer and W Prospect Streets.

Views in this segment are limited by the steep slopes of Queen Anne Hill to the east and by industrial and warehouse buildings to the west. To the west, the slopes of Magnolia Hill can be viewed through much of this segment, and at the south end of the segment, partial views of Elliott Bay are available from a multifamily development at the toe of Queen Anne Hill. Elliott Avenue W is a designated SEPA scenic route, with views of the greenbelts of Magnolia and Queen Anne Hills, and very limited views of Elliott Bay that are framed by large-scale commercial and industrial development. SEPA-designated viewpoints include Bayview Playground, with southward views of Elliott Bay, and Soundview Terrace Park, with westward views of Elliott Bay and Magnolia Hill.

Because of the high level of transportation uses, the prominence of the street in the visual environment, the industrial nature of this segment, and the lack of landscaping and pedestrian amenities, the quality of the pedestrian experience is low throughout this segment and pedestrian activity is low. Viewer sensitivity is also low in this segment, with the exception of the Interbay P-Patch and Interbay Athletic Complex, where viewers' expectations of the enjoyment of open space result in a moderate level of sensitivity.

Table 4.5-6 summarizes the existing visual resources and viewers in the Interbay Segment.

Segment 3: Queen Anne/Seattle Center/Belltown Segment

The Seattle Center is a major urban gathering place and attraction for local citizens and tourists alike. It occupies most of a six-block by five-block area (approximately 74 acres) on a gently rolling terrace carved out of the southern slope of Queen Anne Hill. The Center is part of a diverse neighborhood that includes single-family homes, small mid-rise apartment buildings, and a variety of small to large businesses. Parking lots and structures are available on Mercer Street and Fifth Avenue N, and limited on-street parking is available along First Avenue N, W Harrison Street, and nearby side streets. In the neighborhoods to the north and west of the Center and within the Center, there is abundant vegetation in the form of mature street trees, residential yards and gardens, and landscaping around business properties that adds greatly to the aesthetic appeal of the Queen Anne/Seattle Center neighborhood.

The approach to the Center along W Harrison Street climbs steeply to the east, from Elliott Avenue W to the Key Arena Plaza at First Avenue N. W Harrison Street is a two-way street with one lane for each direction and on-street parking on both sides of the street. Both sides of W Harrison Street have mature street trees with overhead utilities along the north side. Buildings are a mix of ages and mid-rise apartments and businesses. These apartment buildings are historic resources (please see Table 4.11-1 in the Cultural Resources section). Many of the newer buildings include parking garages at street level or underground, and most blocks have small parking lots in addition.

Table 4.5-6. Existing Visual Resources – Interbay

Landscape Unit	Limits	Visual Character	Visual Resources
16th Avenue W	W Emerson Street to W Barrett Street	Terrain: flat, depressed below 15th Avenue Vegetation: volunteer, invasive, some commercial and residential Buildings: medium-sized industrial, converted residential, commercial, church Transportation structures: W Emerson Street, roadway Overhead structures: W Emerson Street, utilities Open space: Interbay Athletic Complex Visual scale: small to medium	Fishermen's Terminal
Interbay	W Barrett Street to W Harrison Street	Terrain: gently sloping Vegetation: golf course, P-Patch, street trees Buildings: residential homes, condos, commercial, industrial Transportation structures: overcrossings, signals, roadway, bus stops Overhead structures: utilities, roadway signage, commercial signage Open space: Interbay Athletic Complex, Interbay P-Patch Visual scale: variable, mostly medium to large	Viewpoint/Park: Kinnear Park, Bowen Viewpoint

Viewer exposure in this segment is high because the Center is a destination point for recreation and is bounded by major thoroughfares (Broad Street, Mercer Street, and Denny Way). Local residents and people visiting the Center for passive recreation may have higher view expectations, because the environs and scenery are important aspects of their experience. Commuters and travelers along the main roads and Center visitors attending sports events, conferences, or special events may have lower expectations of and sensitivity to views.

The Seattle Center presents different views to each of the major streets and neighborhoods it fronts. Mercer Street (a SEPA scenic route) is lined with mature trees and is the theater boulevard for the Center. Mercer Street is also a major connector route with large-footprint, two- to four-story mixed-use buildings (Larry's Market, theaters), a large parking structure for the Center, and parking lots in a range of sizes. Fifth Avenue N is a tree-lined thoroughfare through a commercial and business zone. There are recreational open spaces and buildings (Skate Park, Polly Esther's, EMP), parking lots, the entrance to Memorial Stadium, and the existing Seattle Center Monorail. The EMP and existing monorail together set the visual stage for this corner, creating one of the most prominent and heavily used public entrances to the Center. Broad Street and Denny Way are major arterials with varying visual conditions. Near the Center, Broad Street is a wide boulevard with an openness that is due to the spaciousness of the Peace Garden, the height of the Space Needle, and the absence of tall buildings near the right-of-way. Denny Way is a major east/west travel corridor with high traffic volumes. First Avenue N is a one-way, urban neighborhood street with low-rise apartment and office buildings and street trees.

The Seattle Center is a pedestrian-oriented environment with a wide range of cultural and recreational activities, architectural styles, and landscapes. The street grid pattern of the surrounding neighborhoods partly continues as pathways and access roads within the Center and acts as an organizing structure for the diversity of landscapes, spaces, buildings, structures, activities, and artwork in the center. Inside the Center, Thomas and Republican Streets and Second Avenue N express the grid and define the major pedestrian avenues connecting the Space Needle and Fun Forest area to the International Fountain open space, and then to the neighborhoods. Republican Street, on the north side of the Fountain lawn, with its landscaping and rows of London plane trees, is a key area of the Center, both as a pedestrian experience and as seen across the lawn from Thomas Street. Thomas Street has a pedestrian-oriented character between Fifth Avenue and Second Avenue. West of Second Avenue, Thomas Street's character changes

from a civic quality near Sacred Heart Church and the Fisher Pavilion, to a working zone near the service entrance of the Key Arena and the Seattle Center Garage.

Buildings in the Center are diverse in size, age, and style, and serve a wide range of functions. The majority are three to four stories high, on rolling terrain, amid a matrix of mature trees. The few tall buildings are in the basin (Marion Oliver McCaw Hall) or on hillsides (Key Arena, Center House). From the interior of the Seattle Center, the tall structures that define the Seattle Center (Space Needle and Science Center Arches) are background features. The EMP with the existing monorail emerging from it, the Space Needle, and the International Fountain are dramatic, memorable features. Thomas Street, with its arcades, Children's Theater, and view across the Fountain green, provides a positive pedestrian experience. Five significant historic resources have been identified. For a discussion of historic resources in this segment, please refer to Section 4.11, Cultural Resources.

The landscape plantings in Seattle Center are also diverse in size, age, and design. There are several small courtyards and gardens with special plantings associated with certain buildings (e.g., Kobe Bell garden, Northwest Rooms' courtyard, Founder's Court). The street trees and the gardens in the Center create continuity between the landscapes of the Center and the surrounding neighborhoods.

The rolling terrain, structures, and buildings limit views within the Center, which tend to be along the streets. Memorial Stadium and the theaters enclose the fountain and lawn, but glimpses of Capitol Hill to the east and of Queen Anne Hill to the north are seen from Thomas Street and the Fisher Pavilion, respectively. Views of the signature buildings and structures of the Center are primarily available from Fifth Avenue N and Broad Street. From a distance, the Space Needle is a key physical and visual landmark on the Seattle skyline and is one of the city's most important icons. The Space Needle is partially visible from Bhy Kracke Park and nearly fully visible from Kerry Park, but the Green Line alternatives would not affect these views.

South of Denny Way, Fifth Avenue is predominantly mixed-use, two- to six-story residential and commercial buildings, with a few mid-rise (10 to 15 stories) apartments and hotels. Parking lots and garages are available on most blocks. Fifth Avenue here is a tree-lined, one-way street with parking on both sides and columns for the existing Seattle Center Monorail down the center. The existing Seattle Center Monorail is a significant part of Fifth Avenue physically and visually. Views of the upper portions of the Seattle skyline and the Space Needle are available from the east side of the street. Viewer exposure is moderately high because Fifth Avenue is a major connector street between Queen Anne and Downtown, and because of the existing monorail. Viewer groups are a mix of residents who will have higher expectations about surrounding views, visitors to businesses or friends in the area who will have moderate expectations, and travelers (bicyclists, motorists, transit riders) through the area who will have low expectations with respect to views. Visitors are likely to be pedestrians, and moving slowly enough to be interested in the quality of the visual environment.

There are no views of Puget Sound from Fifth Avenue at street level south of Bell Street. Fifth Avenue follows a broad ridgeline, and then drops below and to the east of the ridgeline around Bell Street. A corridor view of Puget Sound to the west is available from Vine Street. Corridor views of West Seattle and Bainbridge Island are available from Wall and Bell Streets. There are few visual distractions such as signs and overhead utilities. Traffic signals are at every intersection and Fifth Avenue is a major bus corridor.

The pedestrian experience is primarily that of street-level features. The existing monorail guideways act as a kind of linear cap that decreases the sense of scale differential between buildings and obstructs a portion of the views of upper floors of buildings on the side of the street opposite the viewer. The close spacing of the column supports and their placement in the center of the street make Fifth Avenue feel

narrower than it is. However, there are diverse architectural styles and materials and building ages. Decorative friezes, doorways, small balconies, paving patterns, and other features create a varied pedestrian-scale environment. There are several significant and historic resources on Fifth Avenue to Belltown.

Table 4.5-7 summarizes the existing visual resources and visual character in the Queen Anne/Seattle Center/Belltown Segment.

Table 4.5-7. Existing Visual Resources – Queen Anne/Seattle Center/Belltown

Landscape Unit	Limits	Visual Character	Visual Resources
Seattle Center and W Harrison Street		Terrain: rolling terrace and gentle slope Vegetation: street trees, park landscapes, street plantings Buildings: medium residential and commercial to large recreation Transportation structures: existing monorail, signals Overhead structures: light standards and utility lines, road signs Open space: surface parking, parks and courtyards/plaza Visual scale: moderate	Viewpoint/Park: Space Needle Park/Historic: Seattle Center, Statue of Seattle, Chief of Suquamish (Tilikum Place)

"Historic" refers to resources that are either eligible or listed on national or local historic registers.

Segment 4: Downtown/Pioneer Square Segment

Stewart Street and Second Avenue in this segment are major thoroughfares through Downtown Seattle and its intensive commercial and business uses and large multifamily housing buildings. This area includes the Financial District, as well as Pike Place and Pioneer Square Historic Districts. From Fifth Avenue westward, the terrain rises slightly, and then slopes down from Second Avenue to the waterfront to the west and to the King Street Station area to the south. This segment contains a mix of newer high-rise commercial, business, and residential buildings and older buildings, many of which are historic. There is little undeveloped space left. Architectural diversity and quality are generally high, which, together with the large scale of the buildings, create an attractive upscale urban character.

At Stewart Street, the street grid rotates a few degrees from the Belltown grid so that the east/west streets remain perpendicular to the waterfront as it curves southward. Through this segment, Second Avenue is a major thoroughfare with three one-way (southbound) traffic lanes, parking lanes on both sides, and a bicycle lane on the east side of the street. Utilities are underground along Second Avenue and aboveground along Stewart Street. Traffic is controlled by signals at each block. Stewart Street also has overhead trolley wires for the buses.

Viewer exposure is high due to the large volume of people working, living, visiting, or passing through the area. The viewing population is a mix of residents, tourists, shoppers, commuters, people taking advantage of the cultural and culinary attractions in the area, and people who work in the area. Commuters, bicyclists, and travelers would have lower expectations about visual quality than others because they are focused on driving and traffic. The remaining viewers would have higher expectations about the visual quality of the environment either because their activities are elective or because they spend a great deal of time in the area.

There is a broad spectrum of businesses along Stewart Street and Second Avenue in this segment. Uses include high-rise hotel and residential (Westin on Fifth Avenue, the Josephinum at Stewart), the arts (Seattle Art Museum and Benaroya Hall), financial (Federal Reserve, various banks), retail (Nordstrom Rack, Bon-Macy's, Westlake Center), and restaurants. There are large multi-story parking structures and a few parking lots between Stewart and Union Streets, but south of Union Street, some of the new high-rises incorporate underground parking.

There is great diversity of architectural styles and scales and public spaces. South of Union Street, most buildings along Second Avenue are set back from the sidewalk right-of-way, creating wider public pedestrian walkways. Several buildings have arcades or plazas and open spaces (Museum Plaza Building, Broderick Building, Garden of Remembrance at Benaroya Hall, Washington Mutual Building sculpture plaza, the Federal Office Building plaza, the Wells Fargo Bank Plaza) that vary the character of the sidewalk environment. Building entrances are emphasized by either being recessed or covered with awnings. Entrances and windows frequently have decorative archways or panels. Commercial buildings usually have street-level windows for displaying exhibits or products.

Landscaping in this segment is urban and includes street trees from Union Street southward, several public plazas (including the Garden of Remembrance and Washington Mutual Building), and several plazas with planters. The triangle created by Stewart and Olive Streets and Fifth Avenue, called Times Square, is landscaped and has an eight- to nine-story redwood tree.

Most of this segment offers an interesting, vibrant, and engaging public experience. Architectural diversity and detailing, window displays, and varied public spaces create visual interest and variety in scenery. There is also a sense of openness created by the width of Second Avenue, the wide sidewalks, architectural open spaces, and the occasional low building between high-rises. The pedestrian environment is further enhanced by the occasional view down a street or across a low rooftop toward Puget Sound, West Seattle, and Bainbridge Island. Along the alternative alignments between Fifth Avenue and Union Street, there is a great deal of signage including very large neon signs and a two-story billboard in the parking lot between Pine and Stewart Streets.

At Second Avenue and Stewart Street, a view of Puget Sound and Bainbridge Island is available to the west. There is a view of Mt. Rainier looking south down Second Avenue. The Pike Place Market signs can be seen from Pike and Pine Streets. Views across Puget Sound are also available from Marion, Madison, and Spring Streets. The City of Seattle has provided regulations (Seattle Municipal Code 23.49.024) that require upper level setbacks on Marion, Madison, Spring, Seneca, and University Streets to limit the encroachment of building towers on the views of Elliott Bay and landforms to the west. Second Avenue is one-way heading south, and the Washington Mutual Tower is the tallest building in the view from the Stewart Street area. At Spring Street, the Smith Tower and the Vulcan building are key features in the view. Glimpses of the pergola and trees of Pioneer Square to the west are available from James Street and Yesler Way.

Table 4.5-8 summarizes the existing visual resources and viewers in the Downtown Segment. Please refer to Section 4.11, Cultural Resources, for a discussion of historic resources in this segment.

Table 4.5-8. Existing Visual Resources – Downtown

Landscape Unit	Limits	Visual Character	Visual Resources
Stewart Street	Fifth Avenue to Second Avenue	Terrain: gentle slope Vegetation: median planting with redwood tree Buildings: medium to large business and commercial Transportation structures: existing monorail Overhead structures: overhead wires for buses Open space: surface parking Visual scale: moderate to large (view from Second Avenue and Stewart Street)	Park/Historic: McGraw Square
Second Avenue	Stewart Street to Yesler Way	Terrain: gentle slope Vegetation: street trees, plaza gardens Buildings: large office, commercial and residential Transportation structures: none Overhead structures: utilities, light standards Open space: plazas, surface parking Visual scale: large	Viewpoint/Park: view corridors toward Puget Sound, Marion Street, Madison Street, Spring Street, Seneca Street, and University Street Park/Historic (partial listing): Times Square Building, Bon-Macy's, United Shopping Tower/Olympic Tower, Hadfield Building, Exchange Building, Puget Sound Bank, Josephinum Hotel, Doyle Building, Hoge Building, Broderick Building, Dexter Horton Building, Alaska Building, Smith Tower, Pioneer Square, Pike Place Market,

"Historic" refers to resources that are either eligible or listed on national or local historic registers. For a complete list, please refer to Section 4.11, Cultural Resources.

Segment 5: SODO/Chinatown International District/Pioneer Square Segment

The terrain in this segment includes the southward slope in the southeast part of the Pioneer Square Historic District and the filled Duwamish tide flats. Urban development is extremely diverse, ranging from late nineteenth- and early twentieth-century buildings of the Pioneer Square Historic District, to Safeco Field and Seahawks Stadium, to the surrounding warehouse and industrial buildings of the SODO area. The area also includes multifamily housing and large-scale office buildings between the stadiums and the International District, and King Street and Union Stations. Transportation facilities and the stadiums are the key features of the landscape south of the King Street and Union Stations. I-90 off- and on-ramps are located at the north end of this segment, and the Alaskan Way Viaduct runs the length of this segment's west edge. The West Seattle Bridge connects the southwest part of this segment to the west-facing slope of West Seattle. Both industrial and passenger rail traffic is served by several sets of tracks that run in a north/south direction, and rail yards are located adjacent to both Safeco Field and the Alaskan Way Viaduct.

The width of surface streets in this segment varies from five lanes on Second Avenue in Pioneer Square, to seven in SODO. Existing overhead facilities include freeway light standards and sign structures, high-voltage transmission lines, harbor cranes, light standards, and electrical distribution lines. Existing tree cover consists primarily of street trees.

The visual scale of existing urban development is moderate to large in the Pioneer Square Historic District; very large in the vicinity of the Seahawks Stadium and Safeco Field, around the office buildings

to the east of the stadiums, and along the Alaskan Way Viaduct; and moderate to very large in the industrial areas of SODO.

Distant scenic views are limited in this segment by the scale and density of development. The Alaskan Way Viaduct, a designated SEPA scenic route, provides views of Elliott Bay, Puget Sound, the Olympic Mountains, Mount Rainier, and the Downtown Seattle skyline. The skyline can also be viewed looking north from much of the SODO Segment. Attractive foreground views of nineteenth- and early twentieth-century structures can be found by looking west from southeast Pioneer Square toward the heart of the Pioneer Square Historic District. To the east, Beacon Hill is visible across the valley. There are three historic resources in south SODO.

The aesthetic experience of pedestrians in this segment is influenced by several factors. In the southeast area of Pioneer Square, pedestrian activity is high. The maintenance of buildings varies, and parking lots and small-scale twentieth-century structures encroach upon foreground views that are experienced in much of the rest of the Pioneer Square Historic District. The mature trees in Pioneer Square create a pleasant environment and contribute significantly to the overall aesthetic appeal of the area. Near the stadiums, pedestrian activity is high, but primarily on special event or game days. The width of streets, the very large scale of most buildings, parking structures, and the large expanse of stadium-related parking lots are the prominent visual features. In SODO there is little pedestrian activity. The industrial nature of land use, broad streets, numerous parking lots, and signage for businesses are the key components of the visual experience of pedestrians.

Overall viewer expectations are greatest in southeast Pioneer Square, in the vicinity of King Street and Union Stations, and in the Opus and Vulcan building developments east of the stations.

Table 4.5-9 summarizes the existing visual resources and viewers in the SODO Segment.

Table 4.5-9. Existing Visual Resources – SODO

Landscape Unit	Limits	Visual Character	Valued Visual Resources
SODO	Yesler Way to S Horton Street/Alaskan Way Viaduct intersection	Terrain: Mostly level, with moderate slope at north edge of segment. Vegetation: minimal street trees and ornamental vegetation Buildings: commercial and industrial buildings, stadiums. Transportation structures: Alaskan Way Viaduct, Interstate on/off ramps, railroad tracks and rail yards, parking garages. Overhead structures: Alaskan Way Viaduct, Interstate on/off ramps. Open space: gathering spaces associated with stations, offices, and stadiums. Visual scale: moderate to very large.	Viewpoint/Park: Jose Rizal Park, Hing Hay Park Park/Historic: Pioneer Square Historic District

"Historic" refers to resources that are either eligible or listed on national or local historic registers.

Segment 6: West Seattle Segment

The rolling terrain in this segment includes two high, steep-sided ridges, consisting of West Duwamish Greenbelt and Pigeon Point and the landmass on which the majority of West Seattle is located. The ridges trend north to south, and are separated at their northern ends by a basin occupied by the Youngstown neighborhood and Longfellow Creek green space. Extensive greenbelts with mature trees cover western slopes in this segment, extending into the Longfellow Creek basin. Away from the greenbelts, existing tree cover consists primarily of street trees, highly diverse residential plantings, and several wooded parks.

Urban development is almost continuous, ranging from the large-scale commercial and industrial buildings in Youngstown, to the dense single-family neighborhoods on the ridge tops, multifamily developments along arterials, and moderate-scale commercial centers along Fauntleroy Way SW and California Avenue SW. There are several historic resources in this segment. The West Seattle Bridge connects the north part of this segment to the warehouse and industrial buildings of the SODO area and leads to both SR 99 and I-5. Surface road widths vary from five or six lanes for arterial roads to three or four lanes in single-family residential neighborhoods. Existing overhead facilities include light standards, sign structures, and electrical distribution lines.

Existing scale is large along the West Seattle Bridge and in the industrial part of Youngstown, moderate in the neighborhood commercial centers and multifamily areas, and small in the single-family neighborhoods. Recent development in this segment has resulted in an increase in building size and scale. Development includes commercial and office development, and multifamily redevelopment that ranges in height from two to seven stories.

Views from within this segment tend to be to the east or west, from the sides or tops of ridges. Scenic views of the Downtown skyline, Puget Sound, Elliott Bay, the Olympics, the Cascades, and Mt. Rainier are available within this segment. Both the West Seattle Bridge and SW Admiral Way are designated as SEPA scenic routes. Although SW Admiral Way is not near the Green Line alternative alignments, the guideway structure may be visible to both pedestrians and motorists using this route. SW Admiral Way's visual resources include the viewpoint at Belvedere Viewpoint Park and several street end viewpoints.

The aesthetic experience of pedestrians varies greatly within this segment. Single-family residences are key visual features in Pigeon Point and in the residential parts of the Youngstown neighborhood. Generally, pedestrian activity is low, while the nearby large-scale industrial buildings in Youngstown are the prominent visual features. In the Fauntleroy Way SW/SW Alaska Street area, wide arterial streets, stand-alone retail businesses, and their associated signage and parking lots, are the key visual features. The small to medium scale, generally high level of maintenance, and relatively intact nature of the commercial district in the Alaska Junction area create the perception of a distinct neighborhood, the buildings and sidewalks of which integrate the pedestrian experience. In the California Avenue SW and SW Avalon Way areas, middle ground views up and down the street and occasional distant are available to pedestrians; however, the wide arterial streets and largely auto-oriented environment influence the overall pedestrian experience.

Table 4.5-10 summarizes the existing visual resources and viewer group characteristics in the West Seattle Segment.

Table 4.5-10. Existing Visual Resources – West Seattle

Landscape Unit	Limits	Visual Character	Visual Resources
West Seattle	S Horton Street/ Alaskan Way Viaduct intersection to California Avenue SW/ Fauntleroy Way SW intersection	Terrain: rolling Hills separated by Longfellow Creek Basin Vegetation: street trees, ornamental plantings, greenbelt vegetation Buildings: single and multi-family residential, commercial, industrial. Transportation structures: Alaskan Way Viaduct, West Seattle Bridge Overhead structures: Alaskan Way Viaduct, West Seattle Bridge Open space: West Seattle Stadium Park, Camp Long, Duwamish Head and Longfellow Creek Greenbelts, Delridge Playfield Visual scale: small to very large	Viewpoint/Park: Belvedere Viewpoint Park, SW Admiral Way and SW Stevens Street Viewpoint, West Seattle Golf Course and Recreational Area Scenic Routes: Fauntleroy Way SW, SW Avalon Way, Alaskan Way Viaduct, West Seattle Bridge, SW Admiral Way, California Avenue SW, Harbor Avenue SW, 35th Avenue SW

Viewer expectations tend to be highest in residential neighborhoods, which include the Delridge and Youngstown communities and SW Avalon Way, Erskine Way SW, and California Avenue SW areas. Viewer sensitivity is also high in the commercial district of Alaska Junction; and in parks, viewpoints, and scenic routes located within these segments.

4.5.2 Impacts

The following sections summarize the potential visual and aesthetic impacts of the Green Line alternative alignments, stations, and other facilities in each of the project segments. Simulations from selected viewpoints are referenced in the discussions below. As noted previously, these simulations depict the likely maximum station or guideway footprint and height and, in the case of stations, show a conservatively large envelope of station structures without design detail. The views and simulations are provided in Appendix M in the Draft EIS and in Appendix MM in this Final EIS.

Visual impacts are rated as low, moderate, or high according to the following definitions:

- **Low** contrast between scale or character of proposed facilities and the existing environment; viewer groups will not likely notice visual change or expect a scenic viewpoint. Minor changes in shadow levels or light and glare may occur.
- **Moderate** contrast between scale or character of proposed facilities is noticeable but not dramatic; viewer groups are somewhat aware of and sensitive to visual change. Noticeable changes in shadow levels or light and glare may occur.
- **High** contrast between scale or character of proposed facilities and existing environment; viewer groups are sensitive to visual change and expect attractive views or surroundings. Substantial changes in shadow levels or light and glare would occur.

The impacts to regional views from West Seattle, Magnolia, Beacon Hill, and Queen Anne Hill are expected to be low. In most cases, Green Line alternatives would not be readily distinguished from other elements of the visual context, and their effects at this scale were represented in the Seattle Popular Transit Plan Programmatic EIS. Views from Rizal Park and Kinnear Park were not simulated for the same reasons. The Green Line's potential effect on the visual setting of historic resources is evaluated in more detail in Section 4.11, Cultural Resources. However, most identified impacts to historic resources are visual and are considered as part of the overall assessment of visual impacts for each alternative and segment.

Shadow impacts throughout the corridor would vary with alignment orientation, guideway height, and height of surrounding trees or building. In general, higher guideways would produce a softer, more diffuse shadow than lower guideways. The structure of the emergency walkways between the guideways would cast an open, lattice-like shadow between guideway shadows. Light and glare impacts would usually be associated with stations and trains, from interior and safety lighting for the stations, and from interior lighting and headlights on the trains. Shadow, light and glare impacts for particular locations will be discussed in the sections below.

Some alternative alignments involve removing street trees; approximate quantities and species are noted in each segment description. For a list of trees affected by the Green Line alternatives, please refer to Appendix W, Tree Survey Backup Information.

Switches and tail tracks for storage of out-of-service trains have been identified in the discussions that follow, but these features are options and the final locations have not yet been determined.

4.5.2.1 Segment-Specific Impacts

Segment 1: Ballard Segment

In general, the Green Line is expected to result in low overall visual impacts in this area. Visual impacts could result from station and guideway structures, removal of existing buildings, removal or trimming of existing street trees, and the addition of a new bridge crossing of the Lake Washington Ship Canal. Impacts could include view limitations, light, glare and shadow, and visual contrast between proposed development and commercial areas, public open spaces, and the waterfront along the Ship Canal and Salmon Bay.

Alternative 1.1 (West Side of 15th). Guideway and station columns for this alternative would be located on the west side of 15th Avenue NW, within the existing parking lane of the street. The dual beam guideways for this segment would be arranged either vertically or horizontally, depending on the location and station type. The structure would be a prominent visual element of the immediate vicinity, especially for viewers on the west side of the street (Figure M-1, which can be found in Appendix M of the Draft EIS). The sidewalks and buildings on the west side of 15th Avenue NW would receive bands of shadow in the mornings. Shadows during these midday and afternoon periods would fall on the street and would be expected to have little impact on pedestrians and adjacent structures. Overall impacts from shadows would be low to moderate.

There are 140 to 160 trees that could be removed or trimmed along the west side of 15th Avenue NW to accommodate the guideway and columns. Species include red maple, linden, and sweet gum. Heights range from 10 feet (newly planted) to 40 to 50 feet (mature). Most of the trees are in pits or planting strips. For a detailed survey of trees along the Green Line alternative alignments, please see Appendix W, Tree Survey.

The Crown Hill 1 (West 85th) station alternative marks the beginning of this alternative and the north terminus of the Green Line. Located on the west side of NW 85th Street, the structure would displace several small-scale commercial buildings, and would be taller than remaining small to medium scale existing structures nearby. However, existing moderate to high-level impacts generated from the width of the street, traffic, overhead utilities, and existing commercial development would result in moderate to low station area impacts (Figure M-2, which can be found in Appendix M of the Draft EIS).

The NW 65th 1 station alternative would result in removal of several commercial structures on the southwest corner of the intersection of NW 65th Street and 15th Avenue NW. Because the scale, bulk and height of the proposed station would be similar to the existing structures, resulting impacts would likely be low to moderate (Figure M-3, which can be found in Appendix M of the Draft EIS).

The Crown Hill 1A station would be located southwest of 15th Avenue NW and NW 85th Street and would be a single platform terminus station. Impacts from this alternative would be similar to but less than those in the Crown Hill 1 Alternative described above due to its smaller size and lower height with a single platform and the horizontal beams at a lower overall height.

The NW 65th 1A (West) station would be in the same location as NW 65th 1 station, but would be vertically arranged to reduce property acquisition. The additional height of this building, relative to NW 65th 1 station, and the need to configure connecting guideways vertically, would contrast with the height and scale of adjacent structures. Impact levels from this alternative would be moderate.

The visual contrast between the station alternatives NW Market 1 (Southwest) and 3 (Northwest) and the surrounding area is expected to be low (Figures M-4 and M-5, which can be found in Appendix M of the

Draft EIS). Stations along the west side of 15th Avenue NW could create shadows similar to those described for the guideway described above.

Impacts to views along the alignment in this area are expected to be low. View obstruction would be intermittent as one travels down 15th Avenue NW because there are limited regional views along this part of the alignment. Because 15th Avenue NW is bracketed by commercial buildings and businesses, and bends at NW 65th Street, regional views are limited to a narrow view corridor that includes the Ship Canal, Interbay, Queen Anne, and Magnolia. South of NW 65th Street, where 15th Avenue NW curves, the Green Line would be aligned with the Ballard Bridge. Although views of the Ship Canal and Elliott Bay are currently not available at street level in this area, the elevated alignment of all Green Line alternatives would introduce panoramic views of each of these features for Green Line passengers.

Ballard High School, a SEPA designated viewpoint, is located on the northeast corner of this intersection. Existing views from ground level at the school are currently heavily affected by existing development, and viewers at this level would not be expected to experience either obstruction of views or contrast with the character of existing views. However, viewers from upper floors of the school might experience partial obstruction of views to the southwest, including the Ballard Bridge and Magnolia.

The moderate to large scale of the existing buildings along the southern portion of the Ballard Segment and the urban character of the area would result in low-level visual contrast with the Green Line. Four historic resources determined eligible for the NRHP would be affected by Alternative 1.1 (West side of 15th); however, visual quality and aesthetics impacts would be low because the area surrounding these structures is characterized by the transportation corridor and modern commercial and business development of 15th Avenue NW.

Alternative 1.1(s) (West Side of 15th single beam). The single beam configuration along the west side of 15th Avenue NW would have less visual quality and shade impacts than the dual beam configuration of Alternative 1.1 because the support structure would not have the overhead armature of the dual beam configuration (Figure MM-1, which can be found in Appendix MM of this Final EIS). Tree impacts would be the same as Alternative 1.1. Switches at the Crown Hill 1A, NW 65th 1B, and Market 3A stations would provide the transition between single and dual guideway configurations. The single beam arrangement would result in a more open quality along the west side of 15th Avenue NW and shading effects would be lower than with a dual beam arrangement. The narrower width, in comparison with dual beam guideway, would result in lower levels of impacts related to shadow, view obstruction, and potential contrast of the guideway structure with adjacent buildings and land uses. In the immediate area of switches, impact levels would be similar to but somewhat greater than those generated by the dual track guideway in 1.1.

The Crown Hill 1A station would be a single platform terminus station. Impacts from this alternative would be similar to but less than those in the Crown Hill 1 station described above due to its smaller size and lower height with a single platform and the horizontal beams at a lower overall height.

The NW 65th 1B (West) station would be a side platform station located southwest of 15th Avenue NW and NW 65th Street (Figure MM-2, which can be found in Appendix MM of this Final EIS). It would provide a dual beam passing area for the single beam configuration along this alignment. Switches would be located both north and south of the station to facilitate a transition from a single beam configuration to the dual beam passing area at the station and then back to a single beam configuration. The station would generate lower level impacts than other NW 65th 1 station alternatives on this site because of the smaller size of the station structure.

NW Market 3A (Northwest) would be a vertically arranged station connecting to vertical dual beam guideways. It would be located northwest of 15th Avenue NW and NW Market Street. A switch would be located north of the station to allow the transition from a single beam configuration to a dual beam configuration to serve the station. Although this station would be taller than other adjacent structures, existing moderate to high-level impacts from the 15th Avenue NW roadway and traffic, overhead utilities, and nearby moderately large-scale retail and multiple family housing structures would result in a low to moderate impact level.

South of the NW Market station the guideways would remain in a horizontal dual beam configuration to connect with a bridge crossing the Ship Canal.

Alternative 1.2 (Center of 15th). The height, bulk, and scale of project elements in this alternative would be similar to those in Alternative 1.1 (West Side of 15th). The chief difference between the alternatives is that columns in Alternative 1.2 (Center of 15th) would be located in the existing continuous center turn lane. The placement of the Green Line down the center of 15th Avenue NW would be a strong linear visual element for those traveling along the street. Although columns located in the center of the street could result in somewhat greater obstruction of views north and south from the street itself, the center placement would also have the affect of visually dividing the broad expanse of pavement created by the multiple arterial lanes on 15th Avenue NW. Morning shadowing on nearby sidewalks and properties would be less extensive than in Alternative 1.1 (West of 15th) on the west side of the street. However overall effects of shadowing would be greater than those from Alternative 1.1 because Alternative 1.2 (Center of 15th) would cast shadows on the west side of the street in the morning, and on the sidewalk along the east side of the street in the afternoons and early evening.

At Ballard High School, the center guideway in this alternative could result in a band of shadow being cast on the grounds and lower levels of the building when the sun is low on the western horizon. Additionally, the center location of the guideway could add incrementally to potential partial view obstruction compared to Alternative 1.1 (West Side of 15th). Platform stairs for the station could affect a few street trees near the Ballard Swimming Pool, but this would depend on the design.

Approximately 12 lindens may be removed or trimmed along the east side of 15th Avenue NW to accommodate the guideway and columns. Heights range from 10 feet (newly planted) to 25 feet. In addition, trees at Mike's Chili Parlor and the wooded shoreline adjacent to the bridge master's building east of the Ballard Bridge are outside the right-of-way but could be affected by the overhead guideways and columns.

Station alternatives for the center of 15th Avenue NW alternative would have a greater visual impact than Alternative 1.1 (West Side of 15th) due to the pedestrian platforms spanning the whole of 15th Avenue NW. Crown Hill 2 (Center), 65th 2 (Center) and NW Market 2 (Center) would all require platforms that go along both sides of the guideway, which would appear as short bridges across the avenue. NW Market 2 (Center) could have small station buildings on both sides of 15th Avenue NW with walkways extending over the sidewalks to the platforms (Figures M-6, 7, and 8, which can be found in Appendix M of the Draft EIS). In addition, the Crown Hill 2 (Center) station alternative would require a double crossover just south of the station, which would significantly increase the visual impacts due to the additional support and overhead structures. The overhead structures for the stations on the side of the street would shade the street throughout the day with a diffuse lattice-like pattern. Shading would be more intense, possibly continuous, for the center stations due to the greater overhead coverage. Visual quality and aesthetic impacts to historic resources would be the same as Alternative 1.1.1.

Preferred Alternative. Through the Ballard segment, the Preferred Alternative would follow the alignment of Alternative 1.1 (s) (West of 15th with single beam). The single beam configuration along the

west side of 15th Avenue NW would have less visual quality and shade impacts than the dual beam configuration of Alternative 1.1 because the support structure would not have the overhead armature of the dual beam configuration (Figure MM-1, which can be found in Appendix MM of this Final EIS). The stations that would be associated with the Preferred Alternative are Crown Hill 1A (West, 85th), NW 65th 1B (West), and NW Market 3A (Northwest). Switches at these three stations would provide the transition between single and dual guideway configurations, but are expected to be less massive than switches between two horizontal guideways. The single beam arrangement would result in a more open quality along the west side of 15th Avenue NW. The narrower width, in comparison with a dual beam guideway, would result in lower levels of impacts related to view obstruction, and potential contrast of the guideway structure with adjacent buildings and land uses. In the immediate area of switches, impact levels would be similar to but somewhat greater than those generated by the dual track guideway in Alternative 1.1.

The Crown Hill 1A station would be a single platform terminus station. Impacts from this alternative would be similar but less than those in the Crown Hill 1 station described above due to its smaller size and lower height with a single platform and the horizontal beams at a lower overall height.

The NW 65th 1B (West) station would generate fewer impacts than other NW 65th 1 station alternatives on this site because of the smaller size of the station structure.

The NW Market 3A (Northwest) station would have a switch located north of the station to allow the transition from a single beam configuration to a dual beam configuration to serve the station. Although this station would be taller than other adjacent structures, existing moderate to high-level impacts from the 15th Avenue NW roadway and traffic, overhead utilities, and nearby moderately large-scale retail and multiple family housing structures would result in a low to moderate project impact level.

Ballard Crossing. There are three possible designs for the Ballard Crossing Green Line bridge, each with different visual and aesthetic impacts: box girder, arch, and cable-stayed. Three different locations are also examined. All the guideway and bridge alternatives over the Lake Washington Ship Canal would introduce strong linear visual elements and would be evident parts of the view. The bridge alternative that is selected will become a visual landmark. For all alternatives, the Ballard Crossing would be substantially above the view of Ballard Bridge travelers, although piers and approaches to the new bridge would intermittently interfere with views (Figure M-9, which can be found in Appendix M of the Draft EIS). It would provide riders with expansive views of the Lake Washington Ship Canal, Salmon Bay, ships and fishing boats, the fishing terminal, Seattle Maritime Academy and Fishermen's Memorial, the Olympic and Cascade Mountains, Phinney Ridge, Queen Anne Hill, and Magnolia Bluff. The overall visual quality impact would be moderate. There would be an impact to the Ballard Bridge, a historic resource, but other existing linear elements that are prominent in the view, and the distance of viewpoints from most of the alignments would limit the resulting visual contrast.

Diffuse, narrow afternoon and early evening shadows would be cast onto the Ballard Bridge by Alternative 1.1.1 (West Bridge), Alternative 1.1.1(s) (West Bridge single beam), and Alternative 1.1.2 (Far West Bridge). Alternative 1.2 (East Bridge) would cast morning shadows on the Ballard Bridge. None of the bridge alternatives would cause obstructions to aerial navigation, so no lighting would be required by FAA regulations. However, the FAA still has the authority to require the addition of steady, red, low-intensity, directional lighting for aerial navigation at night. For the highest (300 foot) cable stayed option, the FAA could require a flashing, low-intensity red light on top of the bridge tower.

Alternative 1.1.1 (West Bridge) and Alternative 1.1.1(s) (West Bridge single beam) would both follow the west side of the Ballard Bridge (Figure M-10, which can be found in Appendix M of the Draft EIS) and Alternative 1.1.2 (Far West Bridge) would be approximately 200 feet further west, creating less visual presence and less shadowing on the existing Ballard Bridge (Figure M-11, which can be found in

Appendix M of the Draft EIS). Alternative 1.2 (East Bridge) would partially obstruct views of the Ballard Bridge from the 14th Avenue NW boat launch (Figure M-12, which can be found in Appendix M of the Draft EIS). However, overall impacts on the boat launch are not expected to be significant because the bridge would not contrast strongly with the bulk, scale, and visual character of surrounding existing commercial and industrial development. A small number of trees near the shoreline and in private lots to the north could be affected by column placement.

Alternative 1.1.2 (Far West Bridge) would alter the visual character of the existing views west to Salmon Bay and could partially obstruct views west to the Olympic Mountains from the existing Ballard Bridge. Alternative 1.1.2 (Far West Bridge) would have the greatest impact on views from Fishermen's Memorial due to the close proximity, greater height and length, and overall scale. This could alter the character of the existing visual environment, drawing attention from the culturally distinctive and texturally complex fishing related activities on the waterfront, and emphasizing the Green Line Bridge. Alternative 1.2 (East Bridge) is expected to have the lowest impacts on views of the Ballard Bridge and to be the least distracting from attractive views of waterfront activities and development.

Views by the boating public would be somewhat affected by the Ballard Crossing, but impacts are expected to be similar for all alternatives. Views of the Ballard Bridge for boaters could be partially obstructed under Alternative 1.1.1 (West Bridge), Alternative 1.1.1(s) (West Bridge single beam) and 1.1.2 (Far West Bridge) as boats move west or east along the Ship Canal (Figure M-13, which can be found in Appendix M of the Draft EIS). Views of the Ballard Crossing from residences on the northwest side of Queen Anne hill and from residences and public areas (e.g., Lawton Park) in northeast Magnolia would be moderately affected by bridge alternatives. Some distant views could be altered for locations on lower parts of adjacent hillsides, but given the distance of the bridge from view locations a low to moderate level of change should occur.

The arch bridge and cable-stayed bridge designs for Alternative 1.1.1 (West Bridge) are illustrated in Figures M-14 and 15 (which can be found in Appendix M of the Draft EIS), respectively, for comparison.

Table 4.5-11. Key Public Views – Ballard

Relevant View	Distance	Potential Impacts (identifies where possible view obstruction could occur)
Viewpoints		
Ballard High School	F, M	Guideways for center or west alternatives would be visible from the school but the view of Elliott Bay to the south would not be obstructed.
Scenic Routes		
15th Avenue NW	V	Views from the street to Mt Rainier would be partially obstructed by alignment. Views from Ballard Bridge to Olympics, Salmon Bay and Lake Washington Ship Canal, waterfront, would be partially obstructed and/or altered.

F foreground (less than ¼ mile).

M mid-ground (¼ to 1 mile).

V view obstruction varies depending on location of the viewer.

Segment 2: Interbay/Magnolia Segment

Overall, the height, scale, and broad linear visual elements of the Green Line columns, guideway, and stations would not contrast strongly with the existing visual character of existing visual features in this segment (Figure M-16, which can be found in Appendix M of the Draft EIS). The scale and bulk of proposed stations would be about the same as much of the mixed multifamily/commercial development in the north end of the Interbay Segment. However, existing impacts from traffic on 15th Avenue W,

overpasses, rail-related development, parking lots, and a trend toward large-scale commercial and industrial development diminish the potential for visual contrast between proposed development and existing visual features. Along Elliott Avenue W in the south portion of this segment, proposed alignment alternatives would not contrast significantly with the size, bulk, or character of existing moderate to large-scale office, industrial and warehouse structures. Street trees would be removed or trimmed for either alternative.

Alternative 2.1 (West Side of 15th/Center of Elliott) would pass adjacent to the Interbay Athletic Center and the Interbay P-Patch located north of W Wheeler Street. While the Green Line's guideway is not expected to shade the Interbay Athletic Center, the west alignment may cast shade on portions of the P-Patch for a short time during clear mornings. Several historic buildings occur along the segment, most with minor visual quality impacts, but up to two would have the guideways pass overhead (see Section 4.11, Cultural Resources). Storage tracks at W Mercer Place and Elliott Avenue W and switches on both sides of the storage tracks would have a moderate visual impact but would not block views due to the existing railroad tracks and industrial buildings in that area.

Between 110 and 120 street trees could be removed or trimmed along the west side of Elliott Avenue W to accommodate the guideway and columns. Species include red maple, hornbeam, zelkova, purple plum, and sweet gum. Heights range from 10 feet (newly planted) to 40 to 50 feet (mature). Most of the trees are in pits or planting strips. Two small greenbelts along the Emerson-15th Avenue N interchange would be affected also due to tree and vegetation removal.

Shadow impacts for this alternative would be similar to those described for the Ballard Segment. Shadows in the morning would reach the west sidewalk of Elliott Avenue W and shadows in the evening would reach the east sidewalk of 15th Avenue W.

The Dravus 1 (16th) station alternative and platform would remove the QFC building and several trees (Figure M-17, which can be found in Appendix M of the Draft EIS). Shadow impacts would result from afternoon shade on 16th Avenue W.

The Dravus 1A (16th) station would not require the removal of any buildings since it is within the parking area for the QFC store. This station would have similar visual impacts to Dravus 1 (16th) with platforms extending over the sidewalk, but would have a smaller station house than Dravus 1. It would also remove existing buildings on West Dravus Street to the west. Shadow impacts would result from afternoon shade on 16th Avenue W and on the parking lot during the morning.

The Dravus 1B (Barrett) station would remove three small buildings and a few more trees than with only the guideway crossing the area but these buildings would be removed by the guideway for Alternative 2.1. The station would span the block between 15th and 16th Avenue W and cast shadows on 15th Avenue W during the afternoon and on 16th Avenue W during the morning. The station would be higher than the surrounding buildings and the structures it would replace.

The Howe 1 (West) station alternative would have low impacts because it would be in scale and not contrast with the surrounding commercial-industrial buildings (Figure M-18, which can be found in Appendix M of the Draft EIS).

The Howe 1A (Blaine) station over 15th Avenue W would span the southbound lanes of 15th Avenue W. A straddle bent with station columns in the center turn lane would be required in order to span 15th Avenue W. Shadow impacts would result from afternoon shade on 15th Avenue W and throughout the day on the southbound lanes under the platforms. However, the station would not result in a high degree of change or contrast given the surrounding large commercial industrial development.

The Elliott and Mercer 1 (Center) station alternative would have a moderate to high visual impact due to the platforms spanning the width of Elliott Avenue W between the two station buildings. The overhead structure of the platforms and emergency walkways would create shade throughout the day and a bridge over the roadway. The structures are expected to be in scale with and compatible with the commercial-industrial character of the area (Figure M-19, which can be found in Appendix M of the Draft EIS).

The Elliott and Mercer 1A (Center) station would have less visual impact than the Elliott and Mercer 1 (Center) because this alternative would not fully span Elliott Avenue W as station option 1 would (Figure MM-3, which can be found in Appendix MM of this Final EIS). The passenger platforms would reach over the northbound lanes only, to the guideway in the center of Elliott Avenue W. Shading would occur throughout the day on the northbound lanes. The guideways would transition from horizontal to a vertical arrangement at the station. This is not expected to result in additional visual quality impacts.

In response to comments received on the Draft EIS and ongoing engineering and design work, this alignment has been revised slightly to provide slightly better visibility for drivers turning onto 15th Avenue W with the addition of six feet of clearance between the column and the edge of the roadway.

Alternative 2.1(s) (West of 15th/Center of Elliott single beam). The EIS studied a single beam configuration that would result in less visual and shade impacts than the dual beam configuration of Alternative 2.1 because the support structure would not have the overhead armature of the dual beam configuration. Switches at W Mercer Place at Elliott Avenue W (south end) and just south of W Dravus street (north end) would provide the transition between single and dual guideway configurations. The single beam arrangement would result in a more open quality along the west side of 15th Avenue W compared to a dual beam arrangement. Tree impacts and visibility through the columns would remain the same as for Alternative 2.1, but shading would be less than 2.1, with only one guideway overhead.

The single beam configuration would include the Howe 1A (Blaine) station and would switch to dual horizontally arranged guideways for two blocks between W Blaine Street and W Armory Way. Tree impacts would be the same as for Alternative 2.1. South of W Mercer Place, Alternative 2.1(s) would switch to the iris configuration (dual vertically arranged guideways) as it approaches the Elliott and Mercer 1A (Center) station (Figure MM-4).

Alternative 2.2 (Center of 15th/West Side of Elliott). Visual quality impacts due to this alignment and the Dravus 2 (15th) and Howe 2 (Center) station alternatives would be similar to those for Alternative 2.1 due to similar scale and setting of the alternatives. The guideways over the sidewalks and platforms spanning the 15th Avenue W southbound exit ramp and 15th Avenue W, respectively, would change the visual character of the route for pedestrians and motorists. Buildings would be removed for the station alternatives (as discussed above by station) and the overhead platforms would shade the roadway during most of the day (Figure M-20, which can be found in Appendix M of the Draft EIS). The Prospect 3 (West) and Elliott and Mercer 2 (West) station alternatives would have less impact than other two stations because there are no overhead structures spanning the street (Figures M-21 and 22, which can be found in Appendix M of the Draft EIS). Shadow impacts would be afternoon shading of the sidewalk and roadway and would be similar to those described for Alternative 2.1 (West Side of 15th/Center of Elliott).

Considerably fewer street trees and wooded strips would be affected by this alternative. The wooded strips along W Nickerson would be affected by the guideways passing overhead and 15 to 20 street trees could be removed or trimmed. Visual quality impacts to historic resources would be similar to Alternative 2.1.

Preferred Alternative. Through the Interbay segment, the Preferred Alternative would follow the alignment of Alternative 2.1 (West of 15th/Center of Elliott) and would have the same visual quality,

shadow and tree impacts as that alternative. The stations that would be associated with the Preferred Alternative are Dravus 1B (Barrett), Howe 1A (Blaine) to be constructed in the future, and the Elliott and Mercer 1A (Center) options. This configuration would also include the C-1 Operations Center (see below).

The Dravus 1B (Barrett) station would remove three small buildings and trees. The station would span the block between 15th and 16th Avenue W and cast shadows on 15th Avenue W during the afternoon and on 16th Avenue W during the morning (Figure MM-4, which can be found in Appendix MM of this Final EIS). The station would also be higher than the immediately surrounding buildings or the structures it would replace.

For the Howe 1A (Blaine) station, when it is constructed in the future, a straddle bent with station columns in the center turn lane would be required in order to span 15th Avenue W. Shadow impacts would result from afternoon shade on 15th Avenue W and throughout the day on the southbound lanes under the platforms. The contrast would be low, given the commercial/industrial development and transportation-intensive uses in the area.

The Elliott and Mercer 1A (Center) station would have less visual impact than the Elliott and Mercer 1 (Center) because option 1A would not span Elliott Avenue W as option 1 would (Figure MM-3, which can be found in Appendix MM of this Final EIS). The passenger platforms would reach over the northbound lanes only, to the guideway in the center of Elliott Avenue W. The guideways would transition from horizontal to a vertical arrangement at the station. This is not expected to result in additional visual quality impacts.

Interbay Operations Center. Visual quality impacts would likely be low to moderate given the predominately industrial and transportation-intensive setting. The Interbay Operations Center alternative would be the largest element of proposed Green Line development in this segment, covering much of the triangular block between W Wheeler Street and W Armory Way. A guideway switch crossing W Armory Way into the south side of the Operations Center would increase the number of structures. Switches would also be required to connect to the guideway. Additional visual impact would result from the columns and guideways for a double crossover switch just south of W Emerson Street, if constructed for an Interbay Operations Center. Because the existing industrial environment in this area consists of a BNSF railroad yard, warehouse and industrial structures, and large expanses of parking for both the armory and industrial waterfront development, the Operations Center is not expected to contrast with its visual surroundings. The Operations Center would not displace existing moderate to large-scale structures along the west edge of 15th Avenue W. These existing structures would continue to largely obstruct views west from the road corridor, including views of the Operations Center, because the Operations Center would be downhill from 15th Avenue W.

Visual impacts due to the C-1 Operations Center alternative would be slightly higher than those associated with Alternative 2.1 without an Operations Center due to the addition of a switch and guideway turning onto W Armory Way to the Operations Center. However, the guideways would remain in the horizontal arrangement and reduce the visual impact due to the height of the vertical guideways for Alternative 2.1.

At the P-Patch near the Interbay Operations Center, street-edge vegetation could be removed or trimmed for columns, but the tree border inside the P-Patch is not expected to be affected. In early mornings, however, portions of the P-Patch could experience lattice-like shading. The P-Patch is on a plateau north of the proposed Operations Center and part of the view from the P-Patch to the south could be blocked by the top story of the center.

15th Avenue W/Elliott Avenue W is a designated scenic route. Currently, views west along this corridor are largely obstructed by large-scale industrial, warehouse and office structures. Additionally, overpasses, utilities, large commercial signage, and vehicular traffic impact views north and south from the above-mentioned roads. As a result, the Green Line alternatives would not be expected to affect existing scenic views or significantly alter the visual character in the Interbay Segment.

The Interbay Segment contains several designated viewpoints, including Soundview Terrace, Lawton Park, Betty Bowen Viewpoint, Kinnear Park, Briarcliff Elementary School, Bay View Playground, and Magnolia Elementary School. Proposed development would not be visible from several of these viewpoints (e.g., Soundview Terrace and Betty Bowen Viewpoint), and where the Green Line guideway or facilities would be visible from viewpoints, impacts to these resources would be minimal owing to the moderate to high level of existing visual impacts in this segment. A simulation was created for Kerry Park to illustrate the visual impact (Figure M-23, which can be found in Appendix M of the Draft EIS). Potential impacts of the public views are outlined in Table 4.5-12 below.

Table 4.5-12. Key Public Views – Interbay

Relevant View	Distance	Potential Impacts (identifies where possible view impacts could occur)
Viewpoints		
Soundview Terrace	M/V	Portions of the guideway would be visible within the Mercer Street right-of-way, but views south to the Downtown skyline and west to Puget Sound would not be affected.
Lawton Park	F/V	Views of the Ballard Bridge and Ship Canal from the path at the south entrance path to the park would be altered but not obstructed. All Green Line bridge options would be visible above the Ballard Bridge, with Alternative 1.1.2 (Far West Bridge) the most prominent.
Bowen Viewpoint	M/V	Portions of the guideway would be visible within the 15th Avenue W right-of-way, but views west to Puget Sound and the Olympic Mountains would not be affected.
Kinnear Park	F/V	Portions of the guideway would be visible within the 15th Avenue W right-of-way, but views west to Puget Sound and the Olympic Mountains would not be affected.
Briarcliff Elementary School	M/V	Portions of the guideway along 15th Avenue W would be visible, but would not obstruct views east over Interbay of the Queen Anne hillside.
Bay View Playground	M/V	Portions of the guideway along 15th Avenue W would be visible, but would not obstruct views east over Interbay of the Queen Anne hillside or views south of the Downtown skyline and Puget Sound.
Magnolia Elementary School	M/V	Portions of the guideway along 15th Avenue W would be visible, but would not obstruct views east over Interbay of the Queen Anne hillside or views south of the Downtown skyline and Puget Sound.
Scenic Routes		
Elliott Avenue W	F/V	Partial or intermittent view obstruction of terrain and buildings would occur due to the guideway columns as one drives along Elliott Avenue W.
Kinnear Park	M and B	Portions of the guideway for either Interbay alternative within the Seattle Center/ Queen Anne 1 (North) station, 15th Avenue W right-of-way would be visible from Kinnear Park, but views west to Puget Sound and the Olympic Mountains would not be affected.

F foreground (less than ¼ mile).

M mid-ground (¼ to 1 mile).

V view obstruction varies depending on location of the viewer.

B background (farther than 1 mile)

Segment 3: Queen Anne/Seattle Center/Belltown Segment

The Queen Anne/Seattle Center/Belltown Segment has four possible alignment alternatives and several station alternatives. This segment comprises several subsegments that could be combined in different ways.

For all alternatives, key public views have been considered in addition to the visual impacts listed by alternative below. A visual impact that applies throughout this segment is that panoramic views of significant visual resources that were not available before from these places would become available due to the elevation and path of the trains. Light and glare impacts throughout this segment would vary with location. Because of the low to moderate level of existing lighting throughout this segment, additional lighting from stations and the train itself could result in moderate increases in local ambient light levels. Glare would be expected to be low due to the limited level of reflective structures and would be reduced by appropriate design. Station area diagrams, created as part of the urban design studies for Alternatives 3.1 (Seattle Center/Republican) and 3.2 (Mercer), are shown in Figures MM-16 and 17.

Alternative 3.1 (Seattle Center/Republican) would follow the south edge of W Harrison Street between Elliott Avenue W and Queen Anne Avenue N. Guideway height would be comparable in height to most of the buildings. No views from the street would be obstructed, but the guideway would pass near the fourth and/or fifth floors of the mixed-use buildings along W Harrison Street and could come within 10 feet of some façades, depending on the setback (Figure M-24, which can be found in Appendix M of the Draft EIS). The guideways would pass over a brick apartment building (part of a group of buildings eligible for listing in the National Historic register) at the northwest corner of First Avenue N and W Harrison Street, avoiding the need to remove the building, but the structure would be visible from and directly over some of the units, increasing shading. See Section 4.11, Historic Resources, for additional discussion. Shadow impacts along W Harrison Street are likely to be low to moderate because the mid-rise buildings and existing street trees shade the street now, but removing tall trees would change the shadow patterns.

There are 34 street trees that could be removed or trimmed along the south side of the street. Species include London plane tree, purple plum, crabapple, and sweet gum and are planted in pits or planting strips. Heights range from 20 to 50 feet.

The western half of the Northwest Rooms would be removed to accommodate the Seattle Center/Queen Anne 1 (North) or 1A (North) station (Figure M-25, which can be found in Appendix M of the Draft EIS, and MM-18 and 19, which can be found in Appendix MM of this Final EIS). The selected station would have greater physical presence in the Key Arena Plaza than the buildings it would replace. Visual change at the Key Arena Plaza is expected to be high, but the station design could result in positive change by creating greater street appeal along First Avenue N and Republican Street. Either station could also create a stronger plaza space and provide more integration with the Uptown neighborhood business district because the existing Northwest Rooms present a blank façade to the north and west (See Section 4.11, Cultural Resources). Forty to 50 trees would likely be removed for the station, including trees from the Northwest Rooms courtyard and along First Avenue N.

The Seattle Center/Queen Anne 1A (North) station option would be similar in massing and height to the Seattle Center/Queen Anne 1 (North) option, but the lower levels of either station could be designed for retail, commercial, or other uses. Visual impacts for this area could be lower than those of the Seattle Center/Queen Anne 1 (North) station because the station may be more compatible with the neighborhood's commercial character. Along Republican Street north of the fountain lawn, Alternative 3.1 could have moderate to high visual and shade impacts (Figure M-26, which can be found in Appendix M of the Draft EIS) due to the removal of the mature trees along the south edge. About 20 mature London plane trees would be removed on the south side and 24 trees could require trimming on the north side. The shade provided by the Republican Street trees would no longer be available but trees could be replanted south of the guideway to recreate the shaded walk. The mixed tree border at Memorial Stadium would likely be affected by construction of columns.

The Center House and Memorial Stadium, both historic resources, would have visual impacts as discussed in Section 4.11, Cultural Resources. No views within the fountain-lawn area would be interrupted since the guideways would be 40 to 60 feet above street level, but the presence of the guideway and support columns along the north edge of the fountain lawn would alter the views within the Center (Figure M-27, which can be found in Appendix M of the Draft EIS).

Visual impacts from other significant viewpoints are expected to be moderate. Views across the fountain lawn would be altered by the presence of the guideway, but the guideways and columns would echo the form of the covered walkway and the porticos at the theaters. The guideway structure would create a visual enclosure around the north side of the fountain lawn (Figure M-28, which can be found in Appendix M of the Draft EIS) and from the whale sculpture toward Marion Oliver McCaw Hall (Figure M-29, which can be found in Appendix M of the Draft EIS). Views from outside the lawn area would not be affected because the guideways would be well above the pedestrian level and columns would be specifically located to avoid blocking circulation and view ways (Figures M-30 and M-31, which can be found in Appendix M of the Draft EIS). In particular, the view from the Bagley Wright Theater of the fountain and the Space Needle would be unobstructed (Figures M-32 and M-33, which can be found in Appendix M of the Draft EIS) by guideways or columns.

The visual impact from trains passing during festivals at the Seattle Center is expected to vary with the observer and the setting. The kinetic quality of the train overhead could be a positive dynamic during such events for some participants, but could be also be perceived as a distraction. The impact could be greater for gatherings that are quiet or contemplative in nature if the movement and sound overhead is distracting. However, the guideways would not block audience views at outdoor performance or event areas, including Memorial Stadium.

At the northern Fun Forest edge, Alternative 3.1 (Seattle Center/Republican) includes two options for the transition to Fifth Avenue. The existing monorail station and some attractions in the Fun Forest would need to be relocated, as discussed in Section 4.3, Land Use and Neighborhoods. The guideways in that area as seen from the EMP would become a prominent part of the view from EMP but overall could increase the openness of the surrounding area (Figure M-34, which can be found in Appendix M of the Draft EIS). Alternative 3.1.1 (Through EMP) would preserve the memorable view of a monorail through EMP, which was designed around the existing monorail; Alternative 3.1.2 (Around EMP) would not, as the Green Line would pass to the south of the EMP. The honey locust row between the stadium and Fun Forest could be affected, as would the rows of London plane trees along Thomas Street.

The straddle bents required to span Broad Street for either Alternative 3.1.1 (Through EMP) or 3.1.2 (Around EMP) would be a significant physical and visual presence in the area, similar to the existing monorail, but the guideways would be higher and would accommodate change from horizontally to vertically arranged guideways.

Whether Alternative 3.1.1 (Through EMP) or 3.1.2 (Around EMP) is selected in the area of the EMP, Alternative 3.1 –(Seattle Center/Republican) would turn southward to the east side of Fifth Avenue N. (original 3.1 alignment) or it would cross to the center of Fifth Avenue N to the Fifth and Broad 1A station (Alternative 3.1.3). Visual impacts here are expected to be moderate to high because the station alternatives being evaluated, one on either side of John Street, would be larger than existing buildings, which may need to be removed to accommodate the station (Figure M-35, which can be found in Appendix M of the Draft EIS). Both Fifth and Broad alternatives are designed as event stations for the Seattle Center and could have elevated pedestrian walkways for safe, efficient connection to the Seattle Center. In addition, storage tracks could be constructed just east of the station and, if constructed, could project 50 to 100 feet north of the station. Switch tracks could be constructed across Denny Way to transfer trains to the storage tracks. If a storage option is selected, two sets of guideways

(turnback/storage, if constructed, and mainline) would cross Denny Way. The storage tracks would increase the visual impacts, including shadows, scale, and visual clutter. Three 60- to 70-foot London plane trees would be removed for this station.

The Seattle Center/Fifth and Broad 1A station would be a triple-platform station (Figure MM-5, which can be found in Appendix MM of this Final EIS). Visual impacts would be high due to a crossover at the station and increased guideway separation to the north and south of the station. This station would be smaller than the Seattle Center/Fifth and Broad 1 (Southeast), but would have platforms spanning Fifth Avenue N, requiring straddle bents. Fifth Avenue N would be shaded during the middle of the day by the platforms. Scale models of the Seattle Center/Fifth and Broad 1 (Southeast) and 1A stations studying their relationship to the immediate environs are shown in Figures MM-20 and 21, which can be found in Appendix MM of this Final EIS .

Two historic resources in the Seattle Center would be affected by Alternative 3.1 (Seattle Center/Republican) because the guideways would pass close to them, altering their setting. However, visual quality impacts to the Memorial Stadium and Center House would be low to moderate because the monorail does not contrast or conflict with the theme-park nature of the immediate environment around these structures.

In Belltown, Alternative 3.1 would remove the existing monorail guideway to accommodate new columns and guideway beams for the Green Line (Figure M-36, which can be found in Appendix M of the Draft EIS). The prominence of the vertically arranged guideways would be comparable to the existing horizontally arranged monorail, but the guideways would be noticeably higher and the overhead guideways would be vertically separated. The structure would be a major part of the Fifth Avenue streetscape; however, the spatial quality for the pedestrian could be more open than exists today since the columns would be farther apart and the guideways higher than for the existing monorail. Removal of the mature trees that line Fifth Avenue through Belltown would result in noticeable changes in shading, since the trees along the west side of Fifth Avenue shade the street from noon through the afternoon. The street would feel more open, but loss of the trees would alter the existing, distinctive character of an older urban neighborhood.

If a vertical guideway configuration is used, the guideways would pass in front of third- and/or fifth-floor windows, instead of just the third floor as currently exists; a horizontal configuration would primarily affect one floor only. Views along Fifth Avenue toward the Space Needle and toward Downtown could be partially obstructed by the higher guideways and by station platforms and structures. Vertically arranged guideways could have different visual impacts from horizontal guideways along the alignment, and vertical stations could be more compact than the horizontal stations. Conceptual streetscape studies for Fifth Avenue are shown in Figures MM-23 and 24, which can be found in Appendix MM of this Final EIS.

The Belltown 1 (Center-West) station building would be on the west side of Fifth Avenue. Belltown 1A would be an elevator station, smaller than Belltown 1 but in the same location. Belltown 2 (Center-East) would be on the east side of Fifth Avenue. All of the proposed stations would be comparable in scale to the buildings along Fifth Avenue. However, the overhead platforms could be highly visible and would create shadowing on the street because they would reach to the middle of the street. Views of building facades and entrances could be partially obscured by guideway columns. The Belltown 1 (Center-West) station alternative would remove two buildings and a few mature street trees on the west side of Fifth Avenue (Figure M-37, which can be found in Appendix M of the Draft EIS, Figure MM-25, which can be found in Appendix MM of this Final EIS). Belltown 1A (Center-West) and Belltown 2 (Center-East) alternatives would not require removal of any structures (Figure M-46, which can be found in Appendix M of the Draft EIS). No historic resources are affected.

Alternative 3.2 (Mercer). Visual impacts are expected to be moderate to high, similar to Alternative 3.1, although the alignment would be on the north side of W Harrison Street. At the Key Arena plaza, the visual impacts would be similar to those for Alternative 3.1 because the Seattle Center/Queen Anne 1 station would be used. Tree impacts would be similar to those of Alternative 3.1. About 34 street trees, 20 to 55 feet tall, could be removed or trimmed along the north side of W Harrison Street. Species include London plane tree, purple plum, crabapple, and sweet gum and are planted in pits or planting strips.

Visual impacts along Warren Avenue N and Mercer Street are expected to be moderate to high with Alternative 3.2. The guideways would be comparable to most building heights on Warren Avenue and Mercer Street and to the widths of Warren (30 feet) and Mercer (54 feet). The guideway and columns would contrast with the theaters, but less so with the five-story parking structure across from Marion Oliver McCaw Hall (Figure M-39, which can be found in Appendix M of the Draft EIS). The spatial quality of the street could also be altered by the removal of mature existing street trees (to avoid interference with the guideways) and the position of one guideway over the sidewalk. Sixteen trees on the west side of Warren Avenue would likely be removed. They include London plane trees, scarlet oaks, and a madrone, all about 20 to 40 feet tall. Along Mercer Street between 30 and 40 London plane trees, 50 to 70 feet tall, would be affected.

Straddle bents and the guideway spanning Warren Avenue N, Mercer Street, and Fifth Avenue N and the guideway passing over these streets could have a significant impact on the view along Mercer Street, a SEPA scenic route (Figure M-40, which can be found in Appendix M of the Draft EIS). The presence of the Green Line on Mercer Street would also have moderate impact on views from within the Seattle Center theaters and courtyards. The guideways (and columns, depending on placement) could be glimpsed from Founder's Court (Figure M-41, which can be found in Appendix M of the Draft EIS) and from outside the lobby of Marion Oliver McCaw Hall (Figure M-42). Shade impacts on the Seattle Center theaters would be low because the guideway is north of them, and because the buildings and trees on the south side are tall and create shade across Mercer Street.

Visual quality impacts along Fifth Avenue N between Mercer Street and the Fifth and Broad 2 (Harrison) station alternative are expected to be moderate. The guideways and columns would be set back from the street edge by 20 to 30 feet, so there would be little impact on Fifth Avenue N. The apparent width of Fifth Avenue N and the tree canopies along both sides and in the center median would screen the structure from the more active west side of the street (Figures M-43, which can be found in Appendix M of the Draft EIS, and MM-22, which can be found in Appendix MM of this Final EIS). Shadow impacts would be low here because of the existing continuous tree canopy. There is a high diversity of structures on the west side of Fifth Avenue N, whereas the east side is open and with fewer buildings. The Fifth and Broad 2 (Harrison) station (Figure M-44, which can be found in Appendix M of the Draft EIS) would remove one building. This station would be directly east of the EMP and could be similar in height to the EMP, which could obstruct some views of this notable building. These probably would have no impact to street trees.

Alternative3.2.3, a modified alignment for Alternative 3.2, would involve guideways separating to the east and west sides of Fifth Avenue N and would connect to the Fifth and Broad 1A station identified in Alternative 3.1 above. The separate structures would be more visible from Seattle Center grounds, but the overall visual quality impacts are expected to be similar to the original Alternative 3.2 and Alternative 3.1.

In Belltown, Alternative 3.2 (Mercer) would travel on the west side of the street with two options: one to remove the existing monorail's columns and guideway beams and another to retain them. Both would have high visual change, but Alternative 3.2.1 (Remove existing monorail) could result in a positive

change because the overhead view from the center of Fifth Avenue would be opened. Shadow impacts could be similar to existing because the Alternative 3.2 (Mercer) configuration would be taller but closer to the buildings. Because the existing buildings along Fifth Avenue are taller than the planned Green Line guideway, shadow impacts would be limited primarily to morning and midday hours of the day.

Alternative 3.2.2 (Retain existing monorail) would have a high visual impact by virtue of having four guideways over Fifth Avenue (Figure M-45, which can be found in Appendix M of the Draft EIS). Views along Fifth Avenue to the Downtown skyline or the Space Needle would be obstructed more than they are now, and the view along the street would have more overhead congestion due to four guideways. Driving between the two rows of columns could be distracting and in walking under the four guideways one could feel enclosed. Views of building facades and entrances could be partially obscured by columns, which could affect the coherence of the streetscape. The west and east sides could become separate spatial zones.

A west of center alignment along Fifth Avenue was developed as a refinement to a west side alignment due to comments received on the Draft EIS. The guideways would be farther from the property line, increasing the distance between the trains and buildings. Fifty-five to sixty mature London plane trees (ranging 20 to 80 feet tall) on the west side of Fifth Avenue would be removed. A strip of sidewalk between Blanchard and Lenora Streets could be modified to include support columns, resulting in a slightly narrower street there. Shadow impacts would be more significant for Alternative 3.2.2 (Retain existing monorail) with four guideway beams overhead, but the change in shading would be moderate because trees currently shade the street. Replanting would also be less likely with two monorails on Fifth Avenue. Mitigation could include replanting with a shorter tree variety.

Belltown station alternatives Belltown 1 (Center-West), Belltown 1A (Center-West), and Belltown 3 (West) could be used for alignment Alternative 3.2. Belltown 3 (West) would be at the same location as Belltown 1 (Center-West) but would potentially remove five buildings instead of two (Figure M-38, which can be found in Appendix M of the Draft EIS). This station is expected to have less visual impact than the Belltown 1 and 2 stations because the platforms would not extend beyond the edge of the sidewalk. The narrowness of the crossover and the height of the lower platform would resemble a building awning and therefore would not result in a substantial change in spatial quality. The Belltown 1A station would have low visual quality impacts similar to those of the Belltown station alternative.

Alternative 3.3 (Thomas) would have moderate effects similar to Alternative 3.1 from Elliott Avenue W to First Avenue N along W Harrison Street. The alignment would curve southeast across First Avenue N toward the Sonics/Storm Shop at the south end of the Key Arena Plaza. At the south end of the plaza, the Sonics/Storm Shop and NASA building would be removed for the Seattle Center/Queen Anne 2 station (Figure M-47, which can be found in Appendix M of the Draft EIS). The design of the station could have a positive impact on the street character and plaza because it could provide for a more open character to the southwest.

The guideway along Thomas Street would have moderate to high effects, altering the open boulevard character of the street west of the Center House, as well as the setting of some of the buildings, particularly the Center House, which the Green Line would pass directly in front. Along Thomas Street, over 100 mature London plane trees, red oaks, katsura trees, and Norway maples would be removed or trimmed for the guideway and columns. The guideways would pass in front of Sacred Heart Church, the Center House, the Children's Theater, and the Mural Stage courtyard. The spatial quality of the street would be altered because the height of the proposed horizontally arranged guideways would be comparable to most building heights and to the width of Thomas Street. The columns and guideways would narrow the circulation corridor and place the guideways overhead.

The Thomas alignment west of the Center House would be partially visible from the fountain lawn area and the Mercer Street entrances (Figures M-48 and M-49, which can be found in Appendix M of the Draft

EIS). The guideways would be approximately mid-roof level near the church and about proscenium level at the Children's Theater and therefore would not significantly obstruct views of architectural detailing. The theater is set back far enough from the columns so that the entrance would remain visually distinct from the guideway structure and columns. The Center House, a historic resource, would experience adverse visual impacts, as discussed in Section 4.1, Cultural Resources. The Fun Forest would have low impacts. East of the Center House/Fun Forest, the Green Line could be visually compatible with the futuristic Space Needle and carnival character of this area (Figures M-50 and M-51, which can be found in Appendix M of the Draft EIS).

Visual impacts due to the addition of straddle bents required for the Fifth Avenue crossing would be similar to impacts from the existing monorail (Figure M-52, which can be found in Appendix M of the Draft EIS) or Alternative 3.1.

Alternative 3.5 (Second/Denny) from Elliott Avenue W to First Avenue N would have effects along W Harrison Street similar to Alternative 3.1 (Seattle Center/Republican). At the Queen Anne/Seattle Center 2 (South) station alternative, two historic buildings would have adverse visual effects from the structure and station in the vicinity (please refer to Section 4.11.2.1, Cultural Resources). In this alternative, the Seattle Center Pavilion (just west of the Fisher Pavilion) and the Blue Spruce Building would be removed to accommodate support columns, and two buildings and mature trees along Denny Way (a SEPA scenic route in this section) would be removed for columns and the station on Denny Way (Figure M-53, which can be found in Appendix M of the Draft EIS). Forty five to 55 red leaf maple, London plane trees, and redwoods would be removed along Second Avenue and Denny Way to Fifth Avenue.

Straddle bents and/or other special structures would be required for the curves at Thomas Street and Second Avenue N and at Second Avenue and Denny Way. These support structures could be close to the church, but the guideways would be farther away than Alternative 3.3 (Thomas). The columns and guideways would be a significant part of the streetscape as they change from horizontally arranged to vertically arranged along Denny Way. The Denny 3 station would have a moderate impact on Denny Way due to platforms projecting over the sidewalk at about 55 feet and 32 feet. No views of the Downtown skyline would be obstructed, but the view of Elliott Bay could be obscured. Potential impacts of the public views are outlined in Table 4.5-13 below.

Preferred Alternative. The Preferred Alternative through the Seattle Center and Belltown would travel along the south side of W Harrison Street (Alternative 3.1), pass through the Seattle Center on the path of Republican Street and through the EMP (Alternative 3.1.1) to the center of Fifth Avenue N (Alternative 3.1.3). Through Belltown the alignment would be on the west side of Fifth Avenue with the existing monorail guideways removed (Alternative 3.2.1). The stations associated with the Preferred Alternative are Seattle Center/Queen Anne 1A (North), Seattle Center/Fifth and Broad 1A, and Belltown 1A (Center-West). Visual quality, shade, and tree removal impacts for this alternative would be similar to Alternative 3.1, between Elliott Avenue W and Denny Way, and to Alternative 3.2 south of Denny Way along Fifth Avenue.

At First Avenue N the guideways from the south side of W Harrison Street would pass over the Dalmasso Apartments, part of an historic group of buildings, with about eight to twelve feet of clearance, leaving the apartments in place. The guideways would cross over to First Avenue N. to enter the Seattle Center/Queen Anne 1A (North) station. The Seattle Center/Queen Anne 1A (North) station option would be similar in massing and height to the Seattle Center/Queen Anne 1 (North) option, but could have lower visual impacts because the 1A station may be more compatible with the neighborhood's commercial character.

Visual and shade impacts through the Seattle Center would be moderate to high due to the change in Key Arena Plaza, removal and/or replacement of trees, and introduction of the guideway over the Republican Street path and around Memorial Stadium and the Center House. About 20 mature London plane trees

would be removed on the south side of Republican Street and 24 trees could require trimming on the north side. The shade provided by these trees would no longer be available, but trees could be replanted south of the guideway to recreate the shaded edge. The mixed tree border at Memorial Stadium would likely be affected by construction of columns.

The Green Line would pass through the EMP to an alignment with dual horizontal guideways over Fifth Avenue N and then to the Seattle Center/Fifth and Broad 1A, a triple-platform station. Visual and shade impacts would be high due to a crossover at the station and guideway splits to the north and south of the station. This station would be smaller than the Seattle Center/Fifth and Broad 1 (Southeast), but would have platforms spanning Fifth Avenue N, requiring straddle bents. Fifth Avenue N would be shaded during the middle of the day by the platforms.

Visual quality and shade impacts to Fifth Avenue through Belltown between Denny Way and the Belltown station would be as discussed above for Alternative 3.2.1, the west of center alignment removing the existing Seattle Center monorail guideway and columns. The Belltown 1A (Center-West) station alternative would not require removal of any structures (Figure M-46, which can be found in Appendix M of the Draft EIS) and no historic resources would be affected. Alternative 3.2.1 (Remove existing monorail) could result in a positive change because the overhead view from the center of Fifth Avenue would be opened and because the new monorail would use smaller columns than the columns in place along Fifth Avenue now. Because the existing buildings along Fifth Avenue are taller than the planned Green Line guideway, shadow impacts would be limited primarily to morning and midday hours of the day.

Table 4.5-13. Key Public Views – Queen Anne/Seattle Center/Belltown

Relevant Views	Distance (see note)	Potential Impacts (identifies where possible view impacts could occur)
Viewpoints		
Kerry Park	M and B	Portions of the guideway for Alternatives 3.1 and 3.2 near the Seattle Center Queen Anne 1 station would be visible from Kerry Park, but views south to the Downtown skyline and Elliott Bay, and west to Puget Sound would not be affected. The Seattle Center/Queen Anne stations 1 and 2 would be visible from Kerry Park, but not appear out of scale with other Seattle Center buildings.
Seattle Center (Mural Amphitheater, Broad Street Green, Fun Forest rides area, and Thomas Street pedestrian area)	F	Portions of the guideway along Alternative 3.3 (Thomas) would be visible from these places, and guideway columns would intermittently interfere with views into these places from Thomas Street.
Scenic Routes		
Denny Way	B	The guideway of Alternative 3.5 (Denny) could interfere with views of Elliott Bay from some parts of Denny Way.
I-5	B	Portions of the guideway of Alternative 3.1 and 3.2 (Mercer) would be visible but would not obstruct views west to the Queen Anne hillside, or south to the Downtown skyline and Space Needle, or to the mountains and Puget Sound beyond.
Broad Street at Seattle Center	M and B	Partial or intermittent interference with views of the Seattle Center and of Puget Sound from Broad Street along the Seattle Center could occur due to the guideway and columns of Alternatives 3.1, 3.2, and 3.3.

Table 4.5-13. Key Public Views – Queen Anne/Seattle Center/Belltown (continued)

Relevant Views	Distance (see note)	Potential Impacts (identifies where possible view impacts could occur)
Fifth Avenue between Mercer and Stewart Streets	B	Partial or intermittent interference with views of the skyline from Fifth Avenue could occur due to the guideway and columns.
Space Needle Viewpoints		
Myrtle Edwards Park	M	Portions of the guideway along Elliott Avenue would be visible, but the view to the Space Needle would not be affected since the guideway height would be lower than the existing buildings.
Bhy Kracke	M	The view of the Space Needle would not be affected by Green Line facilities.
Shade protected or new parks not yet protected		
None		

F foreground (less than ¼ mile)

M mid-ground (1/4 to 1 mile)

B background (farther than 1 mile)

V view obstruction varies depending on location of the viewer.

Segment 4: Downtown Segment

The Downtown Segment has four possible alignment alternatives and a number of station alternatives. A station service area diagram, created as part of the urban design studies for the Downtown and SODO Segments, is shown in Figure MM-26, which can be found in Appendix MM of this Final EIS. All of the Downtown Segment alignment alternatives would pass by a large number of historic resources, including Smith Tower and King Street Station in the eastern edge of the Pioneer Square Historic District. All alternatives would have similar impacts, with up to 81 resources visually affected. The guideways would be partially visible from Occidental Park and Pioneer Square (Figure M-72, which can be found in Appendix M of the Draft EIS). All alternatives would have a high visual impact, although Alternatives 4.3 and 4.4 would have additional impacts due to stations and structures straddling Second Avenue, as discussed below.

No light and glare impacts are expected in the Downtown Segment under any alternative. Existing light and glare from office and commercial buildings and street lamps are at moderate to high levels throughout this segment; therefore, additional lighting from stations and trains would result in no significant change. The intensity of lighting of the trains is expected to be comparable to existing buildings and vehicles. Some glare from reflective surfaces on trains or stations may occur, but this could be minimized by using low-reflectivity materials or screening, using low-intensity, down-cast lighting (for outside sources).

Computer-modeled shadow studies were generated for all three alignments along Second Avenue for the Seneca-Spring block (Figures MM-37 to 39, which can be found in Appendix MM of this Final EIS) and the University-Union block (Figures MM-40 to 42).. The studies modeled the shadows at 10 a.m., 1 p.m., and 4 p.m. for the winter and summer solstices and vernal and autumnal equinoxes. The general results are that where there are tall buildings, shadows from those buildings will dominate during morning and late afternoon/evening hours. This is the typical condition along Second Avenue. Shadows cast by the guideways will be more noticeable where there are no or low buildings and/or at cross streets. During the winter months, the models show that shadows from buildings dominate throughout the day due to the low angle of the sun. The models do not show the diffuse lattice shadows from the emergency walkway between the guideways, but this would also be present.

Shadow impacts will be most noticeable during summer months. Morning and evening shadow bands from the guideways, for all alternatives, will be wider than the midday bands due to the low angle of the sun and will fall on sidewalks or building fronts. Midday shadows will fall near the guideway for all

seasons so Alternative 4.1 (West) would cast narrow bands of shade on the west sidewalk; Alternative 4.2 (East) would cast narrow bands of shade on the east sidewalk; and Alternative 4.3 (Center) would cast narrow bands of shade down the center of the street.

Throughout the year Alternative 4.2 (East) would cast moving shadows over the east sidewalk from noon to sunset. Because there are particularly sensitive public areas on the east side of Second Avenue, this is a greater negative effect than for shadows falling on the west side. Alternatives 4.1 and 4.3 would also cast moving shadows eastward in the afternoon but the shadowing would occur later in the day. The bands would have wider separation, creating a less dense shadow compared to Alternative 4.2. Alternative 4.1 (West) would provide a slight advantage over 4.2 and 4.3 in that the shadows falling on the eastern edge of Second Avenue would occur late in the day, and for most of the day guideway shadows would fall on the street.

Views of the three alignment alternatives toward the west along the east/west streets vary dramatically from viewpoint to viewpoint, and the impacts on views would vary correspondingly. Of the east/west streets in Downtown, University, Seneca, Spring, Marion, and Madison Streets are designated as view corridors west of Third Avenue. Upper level setbacks are required for buildings on those streets per SMC 23.49.024 with the intent of keeping the view window as wide as possible. The setback requirements apply to development outside the right-of-way (inside private property limits). All three alternatives are within the right-of-way through this area. The guideways would obstruct horizontal bands of the views from some vantage points along these east-west streets, depending on the viewpoint.

Simulations were prepared for all of these streets to illustrate the nature of the impacts (Figures M-73 to 78, which can be found in Appendix M of the Draft EIS) and an additional view of the Pike Place Market sign from new Westlake Park (Figure M-79, which can be found in Appendix M of the Draft EIS). Key public views have been considered in addition to the above visual impacts (Table 4.5-14). In addition to these, the added panoramic views of Elliott Bay, Bainbridge Island, the Olympic Mountains, and Mt. Rainier that were not available before would become available due to the elevation and path of the Green Line trains.

Table 4.5-14. Key Public Views – Downtown

Relevant Views	Distance (see note)	Potential Impacts (identifies where possible view obstruction could occur)
Viewpoints		
Kobe Terrace	F	Portions of the guideway would be visible, but would not obstruct views west to the stadiums, to the skyline of Pioneer Square and Downtown, nor to Puget Sound and the Olympic Mountains beyond.
Harborview Hospital	M	The guideway would be visible as a small element among other industrial and transportation elements in the SODO area, but would not obstruct views west to the skyline of Pioneer Square and Downtown, nor to Puget Sound and the Olympic Mountains beyond.
Jose P. Rizal Bridge	F	The guideway would be visible as a small element among other industrial and transportation elements, but would not obstruct views west to the stadiums, to the skyline of Pioneer Square and Downtown, nor to Puget Sound and the Olympic Mountains beyond.
Scenic Routes		
Alaskan Way Viaduct	F	The guideways would not obstruct views of the Seattle skyline from the Viaduct.

Table 4.5-14. Key Public Views – Downtown Segment (continued)

Relevant Views	Distance (see note)	Potential Impacts (identifies where possible view obstruction could occur)
I-5	F	Portions of the guideway south of Yesler Way would be visible, but would not obstruct views west to the stadiums, or to Puget Sound or the Olympic Mountains beyond.
Downtown Views		
Bay Street	V	No views to Elliott Bay would be obstructed by the guideway.
Eagle Street	V	No views to Elliott Bay would be obstructed by the guideway.
Broad Street	V	No views to Elliott Bay would be obstructed by the guideway.
Clay Street	V	No views to Elliott Bay would be obstructed by the guideway.
Cedar Street	V	No views to Elliott Bay would be obstructed by the guideway.
Vine Street	V	No views to Elliott Bay would be obstructed by the guideway.
Wall Street	V	No views to Elliott Bay would be obstructed by the guideway.
Battery Street	V	No views to Elliott Bay would be obstructed by the guideway.
Bell Street	V	No views to Elliott Bay would be obstructed by the guideway.
Blanchard, Lenora, Virginia, and Stewart Streets		No views would be obstructed by the guideway.
Pine Street	V	The guideway would partially obstruct views of the Olympic Mountains.
Union Street	V	The guideway would partially obstruct views of Elliott Bay, Bainbridge Island, and the Olympic Mountains. The Preferred Alternative 4.1 will ameliorate view impacts here by transitioning to horizontal configuration between stations
University Street	V	The guideway would partially obstruct views of Elliott Bay, Bainbridge Island, and the Olympic Mountains. The Preferred Alternative 4.1 will ameliorate view impacts here by transitioning to horizontal configuration between stations
Seneca Street	V	The guideway would partially obstruct views of Elliott Bay, Bainbridge Island, and the Olympic Mountains. The Preferred Alternative 4.1 will ameliorate view impacts here by transitioning to horizontal configuration between stations
Madison Street	V	The guideway would partially obstruct views of Elliott Bay, Bainbridge Island, and the Olympic Mountains.
Marion Street	V	The guideway would partially obstruct views of Elliott Bay, Bainbridge Island, and the Olympic Mountains. The Preferred Alternative 4.1 will ameliorate view impacts here by transitioning to horizontal configuration between stations
Columbia Street	V	The guideway would partially obstruct views of Elliott Bay, Bainbridge Island, and the Olympic Mountains. The Preferred Alternative 4.1 will ameliorate view impacts here by transitioning to horizontal configuration between stations
Cherry Street	V	The guideway would partially obstruct views to First Avenue buildings. The Preferred Alternative 4.1 will ameliorate view impacts here by transitioning to horizontal configuration between stations
James Street	V	The guideway would partially obstruct views to First Avenue buildings.
Jefferson Street		The guideway would partially obstruct views to Yesler Way buildings.
Yesler Way	V	The guideway would partially obstruct views of Elliott Bay, Bainbridge Island, and the Olympic Mountains.
Space Needle Viewpoints		
Olympic Sculpture	B	No portions of the guideway would be visible, and the view to the Space Needle would not be affected since the guideway height would be lower than the existing buildings.

Table 4.5-14. Key Public Views – Downtown Segment (continued)

Relevant Views	Distance (see note)	Potential Impacts (identifies where possible view obstruction could occur)
Shade protected or new parks not yet protected		
Westlake Plaza	F	No impact.
Future City Hall Plaza	F	Would not be affected by Green Line.
Existing City Hall Park adjacent to King County Courthouse	F	Would not be affected by Green Line.

F foreground (less than ¼ mile).
M mid-ground (¼ to 1 mile).
B background (farther than 1 mile).
V view obstruction varies depending on location of the viewer.

Alternative 4.1 (West Side of Second) would travel along Stewart Street and then along the west side of Second Avenue through Downtown. This is an area with many historic resources that would be affected. For more information, please see Section 4.11, Cultural Resources.

Four station alternatives are being evaluated for this alignment near the intersection of Fifth Avenue and Stewart Street. The Fifth and Stewart 1 (Northwest) and 1A (West) station alternatives would be located at the intersection of those two streets. The Fifth and Stewart 2 (Virginia) station would be located on Fifth Avenue near Virginia Street and spanning Fifth Avenue; visual impacts are expected to be high due to the mass above the street and resulting shadows. The Fifth and Stewart 2A (Virginia-Center) would cross over a portion of the street. The Fifth and Stewart 1 (Northwest) station alternative would occupy most of the block at Fifth and Stewart and require the removal of a large parking structure and several smaller buildings including an historic property (Figure M-54, which can be found in Appendix M of the Draft EIS). A potential elevated walkway between the Stewart station and Westlake Center could be higher than the existing monorail because it would be covered, and this could create a greater visual impact than previously existed. The station would be a substantial presence on the corner because it would occupy most of the site and would be comparable in height to the existing parking garage (about seven stories high) and to the Times Square Building, a historic property. Shadow impacts would be moderate because the Fifth Avenue and Stewart Street corner is fronted on all sides by mid to high-rise buildings. The Fifth and Stewart 1A (West) station option would have similarly high visual impacts as the Fifth and Stewart 2 (Virginia) station because of its overhead pedestrian platforms spanning most of the block between Virginia and Stewart Streets. The 2A station option would have lower impacts because it would not fully span the street. This option also retains the walkway to Westlake Center. The vertically arranged station would not require removing existing buildings because the building would occupy an existing parking lot.

The guideways would curve into the station at Virginia Street on Fifth Avenue and at Fourth Avenue on Stewart Street, thus avoiding traveling directly along the Times Square Building and leaving the Fifth Avenue and Stewart Street intersection unobstructed (except for a potential elevated walkway). The curved guideways could potentially require straddle bents, which, if required, would be a visually prominent component of the Fourth Avenue intersection.

The Fifth and Stewart 2 (Virginia) station would require the removal of the parking structure and two other buildings along Fifth Avenue. This station would have a high visual impact because of the change from vertical to horizontal arrangement of the guideways approaching the station and because of the pedestrian platforms. The lower platform would span Fifth Avenue and could potentially connect the station to the Westin Hotel. The upper platform would be about 40 feet wide and be located between the

guideways, extending over the intersection of Fifth Avenue and Virginia Street about 60 feet above street level. An elevated walkway is also being studied for this station alternative to connect the station's lower platform (about 36 feet above street level) to Westlake Center. The extra-wide upper platform and the change in vertical and horizontal relationships between the guideways would result in additional overhead and support structures. The structure would be a prominent physical and visual element in the blocks between Lenora Street and the intersection of Virginia Street and Fifth Avenue. Shadow impacts due to the station would be moderate; mature trees and mid-rise buildings already shade the intersection of Virginia Street and Fifth Avenue.

The Fifth and Stewart 2A (Virginia Center) station option would have a low visual impact because the platforms would only cover the west sidewalk and parking lane, and the station building size has been minimized to reduce acquisitions and degree of change to the existing streetscape.

Alternative 4.1 (West Side of Second) would then follow the south side of Stewart Street in a vertical arrangement. Alternative 4.1.1 (associated with station alternative Fifth and Stewart 1) would avoid placement directly next to the Times Square building, but Alternative 4.1.2 (station alternative Fifth and Stewart 2) would swing farther south, rounding the corner at Stewart Street and Fifth Avenue. The straddle bents and support structures at the intersection would be prominent physical and visual elements in the intersection and the guideways would pass close to the Times Square building. Depending on the nature of the elevated walkway, it too could be a significant visual feature of the intersection at Stewart Street. The guideway and walkway would partially obstruct views of Times Square's north façade from some vantage points.

Along the south side of Stewart Street, this alignment would affect the mature redwood in the median planter and would use the parking lane for the columns (Figure M-55, which can be found in Appendix M of the Draft EIS). A possible streetscape for Stewart Street is shown in Figure MM-27, which can be found in Appendix MM of this Final EIS, which diagrams the scale and physical relationship of the guideways to the surroundings. The visual impact on the historic buildings along Stewart Street would be adverse (see Section 4.11, Cultural Resources); the decorative band between floors three and four of the Bon-Macy's and the Securities Building could be obstructed from certain vantage points (Figures M-56 and M-57, which can be found in Appendix M of the Draft EIS).

Shadow impacts along Stewart Street would be low because the buildings south of the alignment are taller than the guideways and shade the street and sidewalk.

The alignment would then curve from Stewart Street onto Second Avenue to align with the west side of the street. No structures would need to be removed; however, the street trees south of Union Street would be removed. Fifty to 60 red maples, lindens, honey locusts, and London plane trees could be removed or trimmed between Union Street and S Washington Street. Heights range from newly planted 10 feet to 40 to 50 feet tall. The guideways are expected to have a high visual impact at the Stewart Street/Second Avenue intersection because of the bents that may potentially be used to support the guideways as they curve over the intersection. The straddles, if used, could create visual interference near the Josephinum (an historic property), and the intersection (Figure M-58, which can be found in Appendix M of the Draft EIS). The long-range view down Second Avenue would not be blocked, but would experience different impacts for the different alignment alternatives (Figures M-59, M-60, and M-61, which can be found in Appendix M of the Draft EIS). The Pike Place Market signs would not be obstructed by the guideways or the columns (Figures M-62 and M-63, which can be found in Appendix M of the Draft EIS).

Guideways and columns would be prominent visual features along Second Avenue due in part to the long, straight view down the street and because the height of the guideway would be compatible with the scale of development along Second Avenue (Figure M-59, which can be found in Appendix M of the Draft

EIS). Alternative 4.1 (West Side of Second) would pass in front of the Hoge Building and the Exchange Building, significant historic buildings, obscuring views of the cornice decorations and façade decorations from some vantage points, and resulting in an adverse visual impact to these historic resources (refer to Section 4.11.2.1, Cultural Resources). The view impacts from the third and fourth floor of the Doyle building (located at the southwest corner of Second Avenue and Pine) were studied for center and side alignments and for both vertically and horizontally arranged guideways (Figures MM-32 to 34, which can be found in Appendix MM of this Final EIS). These sketches can apply to views from any building's ground to fourth floors, and impacts will vary significantly depending on the vantage point.

This alignment would pass across the street from Benaroya Hall and next to Seattle Art Museum, two significant public buildings noted for their architectural design and integration of buildings and plaza/open areas. Simulations were created as part of the urban design studies to illustrate visual impacts for the four Downtown Segment alignment alternatives as they pass Benaroya Hall (Figures MM-28 to 31, which can be found in Appendix MM of this Final EIS). These simulations illustrate the scale and spatial relationships of the guideways and columns to the street and Garden of Remembrance at Benaroya Hall. Shadows are shown for a sunny day in the early afternoon. The introduction of the guideways in the area would be a high degree of change.

The overhead structure and columns would change the spatial quality of the sidewalk, but Second Avenue is wide and the overhead structure would still allow the quality of openness to be retained at the pedestrian level. The extension of sidewalks under the guideways and the elimination of parking could maintain the open character. As with Fifth Avenue, building entrances and facades could be harder to discern from a distance due to the presence of columns in front and the guideways overhead (Figure M-67, which can be found in Appendix M of the Draft EIS), which is an adverse impact to the historic resources and to notable civic architecture such as Benaroya Hall. In response to comments received on the Draft EIS, this alternative has been revised. Instead of traveling along Second Avenue in a vertical configuration, the guideways will transition between horizontal between stations and vertical at stations (Figure MM-6, which can be found in Appendix MM of this Final EIS). This revision was made to lessen the visual impact of the guideways from the street, as well as from nearby buildings including Benaroya Hall and the Seattle Art Museum.

Three station locations are associated with Alternative 4.1 along Second Avenue: Pike 1 (West) A and West B, Madison 1 (West), and Yesler 1 (West). All station alternatives are expected to have moderate to high impacts due to the removal of existing buildings and the addition of station buildings and overhead platforms, with platforms and canopies above the sidewalk and street to meet the guideways. All three stations would have high visual impacts on historic buildings.

The Pike and Madison station alternatives would be similar in footprint and height. Pike 1 (West) B would remove the Green Tortoise building and take a parking lot, whereas Pike 1 (West) A would also remove the Eitel Building. These stations would be amid parking lots and garages and the Newmark Building. The Madison 1 (West) alternative would remove the Federal Reserve Bank (Figure M-65, which can be found in Appendix M of the Draft EIS). The Yesler 1 (West) station alternative could have an adverse visual impact on the Smith Tower; however, this would be offset by the removal of the Sinking Ship parking garage. The station would be a prominent feature of the corner, with a structure equivalent to five stories fronting onto Second Avenue, compared to the garage's three levels that slope away from the street. The Yesler Way station would occupy only a portion of the triangular block, leaving the western portion available as an opportunity to create a stronger visual and physical connection to Pioneer Square Park (Figures M-66 and M-67, which can be found in Appendix M of the Draft EIS). The view toward the pergola from the east would no longer be blocked by the garage and the west side of the station plaza could be landscaped to complement Pioneer Square Park and the pergola, effectively

expanding the shaded park area. Sight lines could be established between the west plaza and Occidental Square along Occidental Avenue S and a more attractive view from Occidental Park could result.

Seattle's Land Use Code requires upper level setbacks along designated streets in Downtown. The Madison Street stations would be the only stations falling under this code and they would comply with view corridor setback requirements.

Alternative 4.2 (East Side of Second with Crossover) would affect a number of historic buildings (see Section 4.11, Cultural Resources), but the affected buildings would be the same as those affected by Alternative 4.1, with impacts varying in relative proximity, but all related to the degree of change the introduction of guideways would cause. The guideways curve onto Stewart Street from the west side of Fifth Avenue (Figure MM-7, which can be found in Appendix MM of this Final EIS). After traveling along Stewart Street, Alternative 4.2 would curve through a large parking lot onto Second Avenue to align with the east side of the street. Visual impacts at this corner are expected to be low to moderate because all support structures and the guideways would be outside the pedestrian and traffic zone. The guideway structures here would be comparable in quality and height to the large parking structure to the east. Visual impacts due to Alternative 4.2 would be similar to those of Alternative 4.1, but on the east side of Second Avenue. This alignment would pass next to Benaroya Hall (Figure MM-29, which can be found in Appendix MM of this Final EIS) and the Dexter Horton Building, but would avoid directly fronting the Exchange Building and the Seattle Art Museum. For historic buildings, the visual change would still be considered adverse, and it would remain a relatively high degree of change for other notable buildings.

Four station locations are associated with Alternative 4.2: Fifth and Stewart 3 (Lenora), Pike 2 (East), Madison 2 (East), and Yesler 1 (West). All station alternatives are expected to have moderate to high impacts due to the removal of buildings and the addition of station buildings and overhead platforms, similar to Alternative 4.1. The Fifth and Stewart 3 (Lenora) station is expected to have a moderate visual impact. Four buildings would be removed, but the proposed station would be comparable in scale to the surrounding buildings. The mid-block platforms would create a two-level canopy over the sidewalk but would be high enough (36 and 50 feet) to not significantly affect the spatial quality of the street. Station alternatives Pike 2 and Madison 2 (Figures M-68 and M-69, which can be found in Appendix M of the Draft EIS) would have similar appearances to Pike 1 and Madison 1, and the platform structures would be similar. The impact from the station buildings themselves is expected to be moderate, but the impact due to the overhead platforms would be high. Madison 2 would be located in front of the Wells Fargo Building, removing the stairs and terraces there. The guideways of Alternative 4.2 would alter the spatial quality of the Garden of Remembrance at Benaroya Hall and the paved plaza and sculptures at the Washington Mutual Tower by virtue of the new overhead structure directly adjacent to the buildings. Benaroya Hall, which has a long bank of windows to the south and west, would experience a high degree of change for both external and internal viewers. Shadow impacts would be greater than Alternative 4.1, although still relatively low because the existing trees in the garden and plaza already provide shade throughout the afternoon. The visual impact could be moderate to high because the guideways and columns would contrast with the trees, garden and plaza, and would also be about the same scale as the trees (Figures MM-28 to 31, which can be found in Appendix MM of this Final EIS). Eighty to 85 trees could be removed or trimmed due to the alternative, of species and heights similar to Alternative 4.1.

Alternative 4.2 would cross Second Avenue just south of the Madison 2 (East) station alternative to the west side of Second Avenue to avoid passing directly in front of the Smith Tower. The overhead structure would be highly visible from both a long view down the street and at the crossover due to the special bents or other structures needed to support the curved guideways.

Alternative 4.3 (Center of Second), which would also travel on Stewart Street and Second Avenue, would also affect a number of historic resources. Alternative 4.3 would be the same as Alternative 4.2 through the curve onto Second Avenue from Stewart Street, so impacts would be similar in the area, including adverse impacts to several historic buildings. Visual impacts to the view up or down Second Avenue, however, would be expected to be higher for Alternative 4.3 because guideway columns and beams would be in the center of the street and support structures for stations would straddle the street. Figures M-59 to 61 (which can be found in Appendix M of the Draft EIS) compare the three alternatives from the same viewpoint near Stewart Street and Second Avenue. The view down Second Avenue would be substantially obstructed by the center of street guideway, stations, and street-spanning bent supports. The guideways would be horizontally arranged, so from direct side views the structure would be one rather than two levels. About 20 trees would be affected at station locations, considerably lower than the previous two alternatives.

The Pike 3 (Center), Madison 3 (Center), and Yesler 2 (Center) station alternatives could also have a greater visual impact than side-of-street stations because they would extend across the street to the center of Second Avenue, where the guideways would be located (Figures M- 70 and 71, which can be found in Appendix M of the Draft EIS). This alternative would place a large pedestrian platform for the Yesler Way station in front of the Smith Tower entrance. The lower platforms would be approximately 30 feet above street level, similar in height to the top of the guideways of the existing monorail on Fifth Avenue. On top of the platforms would be additional stairs and/or escalators to reach a second platform at the level of the trains (45 to 50 feet above street level). The straddles that span Second Avenue and the platforms they support would create two covered sections along Second Avenue, substantially affecting the current open character of the street.

Alternative 4.4 (East of Center of Second with Crossover). Visual quality and shadow impacts for Alternative 4.4 along Second Avenue in Downtown would be similar to those of Alternative 4.3 (Center of Second). As with Alternative 4.3, trees would be removed only at station locations. The stations associated with this alternative are Fifth and Stewart 3(Lenora, Pike 2A (East-Center), Madison 2A (East of Center) (Figure MM-8, which can be found in Appendix MM of this Final EIS), and Yesler 1 (West). Visual impacts due to station Madison 2A (East-Center) would be between Madison 3 (Center) and Madison 2(East) because the platforms would extend over a portion of Second Avenue, but less than for the center alignment.

Preferred Alternative. The Preferred Alternative for the Downtown Segment is Alternative 4.1 (West of Second) with Alternative 4.1.2 as the transition from Fifth Avenue to Stewart Street. The Preferred Alternative would have lessened visual impacts compared to the other alignments, although the overall visual impacts would remain significant. The alternative would pass by a large number of historic resources, including Smith Tower and King Street Station in the eastern edge of the Pioneer Square Historic District. This alignment would pass across the street from Benaroya Hall, and next to Seattle Art Museum, two significant public buildings noted for their architectural design and integration of buildings and plaza/open areas. The guideways would be partially visible from Occidental Park and Pioneer Square. The impacts would be lessened with the vertical guideways at stations flattened to horizontal between the stations. This would reduce the impact on views westward along Union, University, Seneca, Marion, Columbia, and Cherry Streets. In addition, an east-to-west crossover is not needed, as required by Alternatives 4.2 and 4.3. Because the Preferred Alternative is aligned with the west side of the street, visual impacts to the view south along Second Avenue would be reduced and the open character of the street would be better preserved.

Station alternatives for the Preferred Alternative are Fifth and Stewart 2A (Virginia), Pike 1 (West) A, Madison 1 (West), and Yesler 1 (West). These stations would have lower visual and shade impacts on sidewalks and the street than the other alternatives because the platforms only extend over the sidewalk

and a traffic lane, leaving the center line and east side unobstructed. The vertically arranged Fifth and Stewart 2A (Virginia Center) station option would not require removing existing buildings because the building would occupy an existing parking lot. Pike 1 (West) A and Madison 1 (West) stations would be similar in footprint and height. Pike 1 (West) A would remove the Green Tortoise building, a parking lot, and the Eitel Building, and would be amid existing parking lots, garages, and the Newmark Building. The Madison 1 (West) station would remove the Federal Reserve Bank (Figure M-65, which can be found in Appendix M of the Draft EIS).

The Yesler 1 (West) station alternative would be a prominent feature of the Yesler-Second Avenue corner. It would be a structure equivalent to five stories fronting onto Second Avenue, compared to the garage's three levels that slope away from the street. The station would occupy only a portion of the triangular block, leaving the western portion available as an opportunity to create a stronger visual and physical connection to Pioneer Square Park (Figures M-66 and M-67, which can be found in Appendix M of the Draft EIS). The Yesler 1 (West) station could have an adverse visual impact on the Smith Tower.

Segment 5: SODO/Chinatown International District/Pioneer Square Segment

In this segment, impacts to visual resources would be associated with visual contrast and view obstruction near the south edge of Pioneer Square Historic District and the area around King Street Station, removal of buildings, addition of station structures and the potential for an Operations Center south alternative, and the presence of the elevated guideway structure. However, impacts to historic resources within the Pioneer Square Historic District are considered as part of the alternatives evaluation in the previous section (Downtown Segment).

Shade, light, and glare would cause varying levels of impact within the segment. In the pedestrian-oriented areas of south Pioneer Square and King Street Station, shading on walkways and gathering places would generate a perceptible level of change to the visual environment, whereas existing visual impacts in the areas adjacent to the two stadiums and in the industrial portion of the SODO Segment would make additional impacts less noticeable. Because of the high level of existing lighting throughout this segment, additional lighting from stations and the train itself would have low to moderate impacts. Some glare from reflective surfaces, primarily at stations and on the monorail trains themselves, may be visible to motorists and pedestrians passing in this segment. This potential impact could be further minimized by incorporating preventive measures in the project design, such as choice of materials or screening.

Alternative 5.1 (East Side of Third/Utah). At the north end of the SODO segment, asphalt parking lots, replacement of historic structures with modern commercial structures, and a general level of disrepair in this area reduce viewer sensitivity to low to moderate (Figure M-80, which can be found in Appendix M of the Draft EIS). Views south to the historic King Street Station would be partially obstructed (Figures M-81 and M-82, which can be found in Appendix M of the Draft EIS). The alignment would cross South Jackson Street diagonally, turning to pass along the west face of King Street Station. The east/west view between Pioneer Square and the International District would be partially obstructed by the guideway structure, as would middle distance views of both King Street and Union Stations (Figures M-83 to M-85, which can be found in Appendix M of the Draft EIS). In addition, views east to King Street Station from the Seahawks Stadium parking lot would be partially obstructed by the guideway and the Weller/King Street 1 (Event) station (Figure M-86, which can be found in Appendix M of the Draft EIS). Otherwise, the Weller/King Street 1 (Event) station would both fit appropriately into its transportation-intensive surroundings, and would not be expected to generate impacts.

Visual impacts from the Safeco Field 1 station alternative, immediately east of Safeco Field, would be low due to the large to extremely large scale of this area, low expectations of viewers for viewpoints, and lack of view obstruction (Figure M-87, which can be found in Appendix M of the Draft EIS). The

stadiums are both very large-scale facilities, surrounded by transportation and industrial uses, and the Green Line would not greatly affect their surrounding setting.

Station alternatives Lander 1 (Northeast), Lander 2 (Southwest), and Lander 3 (Diagonal) would require removal of buildings. Alternatives Lander 2 (Southwest) (Figures M-88, from Appendix M of the Draft EIS, and MM-10, from Appendix MM of this Final EIS) and Lander 4 (Utah) would be associated with the Operations Center (Figure M-90, which can be found in Appendix M of the Draft EIS). Lander 4 would be part of the center and therefore could have the lowest visual impacts of the three alternatives. If the south alternative SODO Operations Center is constructed, it would cause the removal of all existing structures along the south side of Utah Avenue S, between S Lander and S Hanford Streets. Although this would cause substantial change to the visual environment, the industrial nature of the area, large scale of buildings, existing railroad lines and yards, and low viewer expectations of views in this area would result in a low- to moderate-level impact. Twenty to thirty street trees would be removed or trimmed, mostly maples between 15 and 40 feet tall.

Alternative 5.2 (West Side of Third/Utah). Visual impacts of Alternative 5.2 would be similar to Alternative 5.1 along their common alignment near Seahawks Stadium and Safeco Field. Lander 3 (Diagonal) would require removal of buildings but would have no structures over S Lander Street because the station is set back from the right-of-way (Figure M-91, which can be found in Appendix M of the Draft EIS).

In response to comments received on the Draft EIS and ongoing engineering work, the alignment in this area has been altered to provide a shorter crossing of Amtrak and BNSF tracks north of Safeco Field. Impact levels from this alternative would be low because of the scale and nature of the surroundings.

Weller/King Street 2 (Event) would be a horizontally arranged station sized to accommodate event crowds Figure MM-9, which can be found in Appendix MM of this Final EIS). Conceptual studies of the King Street Station area were done as part of the urban design process to evaluate the scale and spatial relationships of the King Street station to its environs (Figure MM-35 and 36, which can be found in Appendix MM of this Final EIS). King Street Station, a historic property, would be adversely affected by the visual change of the guideway (see Section 4.11). Because this station would be located near Safeco Field and existing Amtrak and BNSF tracks, overall visual impacts from this alternative would be low.

The alignment has been revised south of S Royal Brougham Way to make the diagonal crossing of Amtrak and BNSF tracks north of the original crossing, reducing impacts on the Seattle Public Schools property on S Lander Street. Areas adjacent to this alignment currently are affected by BNSF tracks, trains, overhead utilities, and warehouse buildings. Additional impacts from the guideway structures in this area would be low.

Lander 3 (Diagonal) station would be located on private property north of S Lander Street between First and Occidental Avenues S. The station has been revised to be aligned diagonally to the street grid in a northeast to southwest direction. Several commercial structures would be removed as part of this alternative. However, because of industrial settings, existing streets, overhead utilities, and medium- to large-scale buildings in the vicinity, impacts from this alternative would be expected to be low. The Lander 3 station could have lower visual impacts than Lander 1 and Lander 2 because it does not front onto Lander Street. Ten to 15 trees could be removed. This alternative includes storage tracks and switches on both ends on Third Avenue S at S Holgate Street. These structures are directly adjacent to the railroad corridor and are expected to have a low visual impact due to the transportation structures in the area.

At the south end of the segment, the guideway would pass over the Alaskan Way Viaduct to meet the West Seattle Bridge. The view from under S Hinds Street in SODO is illustrated in Figure M-92, which can be found in Appendix M of the Draft EIS. Potential impacts of the public views are outlined in Table 4.5-15 below.

Alternative 5.2(s) (West Side of Third/Utah single beam). The single beam configuration would result in lower visual quality and shade impacts than the dual beam configuration of Alternative 5.2 because the support structure would not have the overhead armature of the dual beam configuration. Switches at the Safeco Field and Lander stations would provide the transition between single and dual guideway configurations, but are expected to be less massive than switches between two horizontal guideways. The single beam arrangement would have a more open quality along the street and shading effects would be lower than a dual beam arrangement. Tree impacts would be the same as those for Alternative 5.2.

Preferred Alternative. The Preferred Alternative for the SODO Segment is Alternative 5.2(s), an alignment that would feature a single beam configuration on the west side of Third Avenue S south of Safeco Field and a diagonal approach to Utah Avenue S with a dual beam passing area at the Lander station and another dual beam passing area near S Horton Street. The single beam configuration would have lower visual quality and shade impacts than a dual beam configuration because the support structure would not have the overhead armature of the dual beam configuration. Stations included in the Preferred Alternative would include: Weller/King 2, Safeco 1, and Lander 3 (Diagonal).

Weller/King Street 2 (Event) would be a horizontally arranged station sized to accommodate event crowds. This station is larger than Weller/King Street 1 (Event) station, but because it would be located near Safeco Field and existing Amtrak and BNSF tracks, additional impacts from this alternative would be low.

Table 4.5-15. Key Public Views – SODO

Relevant Views	Distance (see note)	Potential Impacts (identifies where possible view obstruction could occur)
Second Avenue and Yesler Way	F V	Guideway structure could partially obscure southward views of King Street Station.
S Jackson Street between Second and Sixth Avenues	F-M V	Guideway structure could partially obscure views between Pioneer Square and the International District.
Seahawks Stadium Parking Lot	F	Guideway structure could partially obscure views of King Street Station and contrast with the station's historic architecture.

F foreground (less than ¼ mile).

M mid-ground (¼ to 1 mile).

B background (farther than 1 mile).

V view obstruction varies depending on location of the viewer.

Visual impacts from the Safeco Field 1 station alternative, immediately east of Safeco Field, would be low due to the large to extremely large scale of this area, low expectations of viewers for viewpoints, and lack of view obstruction (Figure M-87, which can be found in Appendix M of the Draft EIS). Similarly, because existing transportation and industrial uses currently generate high-level impacts in this area additional impacts from the Green Line would not greatly affect their surrounding setting.

Lander 3 (Diagonal) station would be located on private property north of S Lander Street between First and Occidental Avenues S. The station has been revised to be aligned diagonally to the street grid in a northeast to southwest direction. Since it does not front onto S Lander Street visual impacts to the street would be low. This station alternative could have lower impacts than either the Lander 1 or Lander 2 alternatives. Three commercial structures would be removed as part of this alternative. However, because of existing impacts from streets, overhead utilities, and medium to large scale buildings in the vicinity, additional impacts from this alternative would be expected to be low.

Segment 6: West Seattle Segment

In this segment, visual impacts could result from the introduction of station and guideway structures, removal of existing buildings, and the potential addition of a new bridge spanning the Duwamish Waterway or the addition of a guideway structure atop the existing West Seattle Bridge. Impacts could include view limitations, introduction of light, glare and shadow, and visual contrast between proposed development and commercial areas, residential neighborhoods, and a park.

For all alternatives in this segment, shade would cause varying levels of impact. In pedestrian-oriented areas (e.g., California Avenue SW and the commercial area at the intersection of SW Alaska Street and 44th Avenue SW), shading on walkways and gathering places would generate a perceptible level of change to the visual environment. However, in areas along upper SW Avalon Way, and SW Alaska Street existing impacts from heavy traffic and automobile oriented businesses would reduce the expectation for an impact-free environment. Shade from a new monorail-only bridge over the Duwamish Waterway (Alternative 6.2) could cause a substantial increase in shading in areas below the bridge.

High levels of existing lighting in parts of this segment (e.g., West Seattle Bridge, Fauntleroy Way SW) would likely result in low-level impacts from additional light and glare from the Green Line. However, viewers in residential areas (e.g., California Avenue SW, SW Avalon Way) would be more likely to perceive changes in the visual environment generated by light from stations and trains, including the trains' headlights, which would be similar to a typical automobile's. Additionally, glare from reflective surfaces of stations and trains may be visible to motorists and pedestrians passing through this segment.

Alternative 6.1 (West Seattle I) as it enters the south end of this segment would have a flyover crossing of an elevated section of SR 99 that could partially obscure north/south views along the viaduct, a designated SEPA scenic route. Because this would be experienced in the brief time that motorists approach and pass beneath the flyover, the level of this impact would be low to moderate. Pedestrians and cyclists passing between SODO and West Seattle would also have their views partially obscured by the support columns of the flyover structure; however, because of existing impacts from elevated roadway and industrial uses in this view area, impact levels would be low.

Crossing the West Seattle Bridge, the guideway would be located between the east and west lanes of the bridge, approximately on the bridge's centerline. The guideway would be elevated, allowing for north/south views to the Downtown skyline and the surrounding waterfront for Green Line passengers. However, the guideway columns could briefly obstruct these same views for motorists passing over the bridge. Although the guideway on the West Seattle Bridge would be visible from Belvedere Viewpoint Park on SW Admiral Way, the distance of the viewpoint from the bridge and the very large scale of the bridge would not result in significant changes to this visual environment (Figure M-93, which can be found in Appendix M of the Draft EIS). Similar to the new Ship Canal Bridge, the FAA could require a low-intensity, steady red light for purposes of air navigation atop the Green Line structure on the West Seattle Bridge.

Under Alternative 6.1, there are two options for the transition between the West Seattle Bridge and the Delridge neighborhood. Under Alternative 6.1.1 (Past Pigeon Point), the guideway would remain on the West Seattle Bridge until it intersects Delridge Way SW. Under Alternative 6.1.2 (To Pigeon Point), the guideway would pass through the north edge of the W Duwamish Greenbelt at Pigeon Point between W Marginal Way SW and the eastbound onramp for the bridge. This would result in removal of vegetation from the greenbelt and could result in visual impacts to views of the greenbelt. Ecosystem impacts from vegetation removal are discussed in Section 4.15, Plants and Animals. Up to 40 trees could be removed along Delridge Way SW.

The EIS studies a single beam configuration for the West Seattle Bridge crossing (Alternative 6.1(s)). This single beam configuration would be expected to result in lower visual impacts than Alternative 6.1 because the support columns could be somewhat smaller than those required for a dual beam configuration and because the guideway would not need the overhead armature of the dual beams.

The height and scale of the guideway would contrast with the small scale of some of the structures along Delridge Way SW; however, existing impacts from arterial traffic on Delridge Way SW reduce viewer expectations, resulting in a moderate level of impact from the route. Crossing the Longfellow Creek Greenbelt basin would require a guideway height of approximately 75 feet. Most land uses in this area, including office buildings, parking facilities, and the Nucor Steel Plant, would not be affected by resulting height and scale impacts. The Delridge 1 (26th) station and guideway alternatives would have moderate to high visual impacts on Longfellow Creek Greenspace because the station and guideway would be aligned over Longfellow Creek near the intake culvert at SW Andover Street (Figures M-94, which can be found in Appendix M of the Draft EIS, and MM-11, which can be found in Appendix MM of this Final EIS). Tall deciduous trees would screen the visual impact from within the Greenspace. The potential increase in parking near the station and the change in vegetation in the buffer could contribute to the impacts. Additional discussion is also provided for effects in this area in Section 4.15, Plants and Animals, and Section 4.10, Parks and Recreation.

Ascending from SW Andover Street the alignment would travel along SW Avalon Way, a SEPA scenic route. The guideway's location in the right-of-way's center would partially obscure scenic views southward from the street to the Downtown skyline (Figure M-95, which can be found in Appendix M of the Draft EIS). Southwest views of the Cascade Mountains could also be affected, although these impacts would likely be occasional and minimal. Twenty to 25 lindens, maples, and other varieties of trees would be removed along SW Avalon Way and Fauntleroy Way SW. Arterial traffic, the relatively large scale of the predominantly multifamily residences in this area, and automobile-oriented land uses would likely not result in impacts related to contrast of height, scale, and character. Although the Avalon 1 (Center) station would be located in the road's center, it is not located in a section of SW Avalon Way with scenic views or sensitive viewers (Figure M-96, which can be found in Appendix M of the Draft EIS). Passengers on the Green Line would have enhanced views in this area, owing to the elevated position of the monorail and resulting lack of obstruction by vehicles, commercial signage, and low commercial structures in this area.

Along both Fauntleroy Way SW and SW Alaska Street, Alternative 6.1.3 (Northwest Side of Fauntleroy) would travel along the west edge of the roadway and Alternative 6.1.4 (Southeast Side of Fauntleroy) would be located on the east edge. Visual impacts along the alignment in this area are not expected to be significant, because this area features primarily automobile-oriented businesses and high volumes of arterial traffic. About 10 linden could be removed along SW Alaska Street.

As the alignment turns southward, it would enter an area in which development is comprised of primarily small-scale single-family residences and small- to moderate-scale multifamily residences and commercial buildings. Along 42nd Avenue SW, both the guideway and the vertical Alaska Junction 1 (42nd/Edmunds) station would be located on the west edge of the street (Figure M-97, which can be found in Appendix M of the Draft EIS). The proposed Green Line developments match the scale and height of surrounding land uses; however, they may partially obscure views to the Olympic Mountains from the mixed residential/commercial area on the east side of the street. Crossing to California Avenue SW, the alignment would require removal of several small-scale residential and commercial structures, resulting in a moderate change in the visual character in this area.

Alaska Junction 1A would be a side platform station in the same location as Alaska Junction 1. This station alternative would affect its surroundings similarly to Alaska Junction 1 with contrasts due to height, potential view blockage, and removal of existing buildings.

On California Avenue SW, views southward and downhill along the roadway would be partially obscured by the guideway (Figure M-98, which can be found in Appendix M of the Draft EIS), because the alignment would travel along the center of the road right-of-way until reaching the southern terminus station at Morgan Junction, located on the west side of California Avenue SW. Although there are no existing public east/west scenic views along this part of the route, the guideway structure could obscure foreground distant and cross-street views for residents and businesses along California Avenue SW (including a Seattle landmark at 4740 California Avenue SW). This alignment would remove or trim about twenty pines and lindens on California Avenue NW and ten to fifteen maples and fruit trees along Fauntleroy Way SW.

Morgan Junction 1A (West) would be a single platform station in the same location as the Morgan Junction station in Alternative 6.1, and would affect its surroundings similarly, although impacts would be lower than Morgan Junction 1 due to its smaller size with the single platform.

The EIS studies another opportunity for a single beam configuration along California Avenue SW. Alternative 6.1.6 (s) (West side of California single beam) would be aligned on the west side of California Avenue SW (Figure MM-12, which can be found in Appendix MM of this Final EIS). Between Morgan Junction and just south of SW Hudson Street, this alternative would utilize a single beam. Impacts from this alternative would be similar to those along California Avenue SW in Alternative 6.2 (East side of California). North/south views along California Avenue SW would be less obscured than those in Alternative 6.1; however, viewers on the west side of California Avenue SW would likely experience a higher level of impacts from view obstruction and the scale of the guideway. Additionally, following the west edge of the road right-of-way could entail permanent removal of about twenty existing street trees. The single beam guideway would generate impact levels somewhat lower than those in dual beam alternatives on California SW, except in areas with switches (Morgan Junction and south of SW Hudson Street), where impacts would be similar to dual beam alternatives.

The Morgan Junction 1 station alternative would require the removal of several small businesses. This station would have double crossover switches just north of SW Graham Street, which would increase the bulk and width of the alignment and station here. Because land uses adjacent to the station include the recent addition of moderate to large-scale commercial buildings, the station would be expected to have a moderate impact on the area (Figure M-99, which can be found in Appendix M of the Draft EIS).

Alternative 6.2 (West Seattle II) would include construction of a high-level bridge, north of the West Seattle Bridge (a SEPA scenic route), to cross the Duwamish Waterway. The bridge would be about the same height as the existing West Seattle Bridge, but it would be a prominent feature in the visual landscape and could generate several types of visual impacts. As an element of mid-ground and background views (Table 4.5-16), the proposed bridge would match the scale, height, bulk, and form of the existing bridge, and would not be expected to cause significant impacts. This structure would be a key part of foreground views, especially those from beneath the bridge and on the adjacent waterfront. Despite high-level existing impacts from the existing bridge and adjacent industrial land uses, the proposed bridge would noticeably alter the visual character of the existing visual resources. Additionally, the view north to the Seattle skyline from the existing bridge may be partially obstructed by the proposed Green Line Bridge, and the character of this scenic route would be altered.

Table 4.5-16. Key Public Views – West Seattle

Relevant Views	Distance (see note)	Potential Impacts (identifies where possible view obstruction could occur)
Alaskan Way Viaduct (6.2)	F-M-B V	Flyover could partially obscure skyline views.
West Seattle Bridge	F-M-B V	Columns for guideway could partially obscure views.
Belvedere Viewpoint Park	B	Proposed changes could cause low-level impacts from change in visual character.
SW Avalon Way	B V	Guideway would partially obscure skyline views.
35th Avenue SW	M-B V	Guideway columns could partially obstruct views; guideway would contrast with existing character.
35th Avenue SW and SW Oregon Street	M-B V	Guideway columns could partially obstruct view; guideway could contrast with existing character.
West Seattle Stadium Park	F-M	Proposed changes would cause impacts from change in visual character.

F foreground (less than ¼ mile). M mid-ground (¼ to 1 mile).
B background (farther than 1 mile). V view obstruction varies depending on location of the viewer.

This alignment would avoid the West Duwamish Greenbelt and Delridge neighborhood by turning broadly through sparsely developed property west of Delridge Way SW. The alignment would follow the southeast edge of SW Andover Street, to station alternative Delridge 2 (Andover) (Figure M-100, which can be found in Appendix M of the Draft EIS). Approximately twenty-five bigleaf maple, alder and Douglas fir could be removed along SW Andover and SW Yancy Streets.

Impacts along SW Avalon Way would be similar to those generated by Alternative 6.1, except that instead of continuing toward Fauntleroy Way SW, the alignment would turn south to follow the east edge of 35th Avenue SW (a SEPA scenic route) and the west edge of the West Seattle Stadium Park. The Stadium Park is a City of Seattle Park and SEPA viewpoint (see Section 4.10, Parks and Recreation). Scenic public views along this part of the alignment are toward the east, and include the Cascade Mountains and distant hillsides. These views would not be obscured by the guideway; however, guideway columns could cause occasional partial obstruction. This could be partially mitigated by spacing the columns as far apart as possible.

Alternative 6.2.1 would travel along the east side of 35th Avenue SW adjacent to the park use the Avalon 2A (35th) station alternative. This station would be located on park property, on the sloped, wooded area that is currently a 40- to 50-foot-tall screen of mature conifers on the west side of a sports field (see Section 4.2, Displacements and Relocation). Approximately 50 to 60 trees would be removed. The intersection of 35th Avenue SW and SW Oregon Street is a designated SEPA viewpoint (Figure M-101, n Appendix M of the Draft EIS). The viewpoint is currently obstructed by the evergreen screen. Because the proposed station would be elevated, replacing the conifer screen with the proposed station would partially recreate this viewpoint. Impacts due to this station alternative would be high because the wooded buffer would be removed (Figure M-101) and park property would be lost (please refer to Section 4.10.3, Mitigation, for a discussion of replacement property). This would affect views from and to the stadium site since the wooded hillside provides a backdrop to the field events inside the stadium. The guideways and station would contrast with the character of the existing amenities.

Alternative 6.2.2 would be aligned along the center of 35th Avenue SW, between SW Avalon Way and SW Alaska Street. The center alignment would reduce obstruction of westward views from southbound lanes of 35th Avenue SW, and increase them for northbound drivers. The center alignment would obstruct north-south views along the roadway, however these are not designated scenic views. By avoiding the

east edge of West Seattle Stadium Park, this alternative would avoid disturbance and removal of the tree screen, and reduce the level of contrast between the guideway and the park.

Avalon 2B station alternative would serve the center-aligned guideway of Alternative 6.2.2. Located in the center of 35th Avenue SW, it would not affect West Seattle Stadium Park through removal of trees or by encroaching on park land. Visual contrast between park amenities and the station would be much less than with Avalon 2A because of increased distance and visual screening between the park and station (Figure MM-13, which can be found in Appendix MM of this Final EIS).

The alignment would then turn west, following the center of SW Alaska Street though an area of mixed small to medium scale retail and multi-family residences. Although existing visual resources do not include scenic public views, foreground and cross-street views would be partially obscured by the guideway structure. Visual impact levels would be moderate through most of this part of the alternative, with the exception of the area surrounding the intersection of SW Alaska Street and 44th Avenue SW. Here, the guideway would contrast with the well-maintained early to mid twentieth century buildings, the pedestrian-oriented streetscape, and the closely spaced businesses, resulting in a marked contrast with the existing visual resources. About ten mature trees would be removed for this alignment.

Alternative 6.2.1 would align with the north side of SW Alaska Street. East/west views along SW Alaska Street would be less obscured than with a center alignment; however, viewers on the north side of SW Alaska Street would likely experience a higher level of impacts from view obstruction and the scale of the guideway.

The alignment would turn south to follow the east side of 44th Avenue SW for one block, and would include Alaska Junction 2 (44th/California) station alternative (Figure M-102, which can be found in Appendix M of the Draft EIS). Current development in this area includes a parking lot and several small to mid scale apartments and commercial buildings. Although the Green Line would likely contrast somewhat with the visual character of this area, the resulting impacts would not be significant.

The alignment would take a broad turn eastward, joining California Avenue SW and following the east side of the street to the southern terminus. Impacts along this part of the alternative would be similar to those along California Avenue SW in Alternative 6.1. North/south views along California Avenue SW would be less obscured than those in Alternative 6.1; however, viewers on the east side of California Avenue SW would likely experience a higher level of impacts from view obstruction and the scale of the guideway. Additionally, following the east edge of the road right-of-way could entail permanent removal of existing street trees. Approximately 110 lindens and 10 maples would be removed or trimmed.

Alternative 6.2 would extend southward past Fauntleroy Way SW, terminating with Morgan Junction 2 (Center) station alternative, which would be located near the center of the road right-of-way (Figure M-103, which can be found in Appendix M of the Draft EIS). The Morgan Junction 2 station alternative would have a double crossover switch just north of the station and tail tracks with a single crossover south of the station, for storage of out-of-service trains. The switches would create a greater visual impact combined with the station because of the extra columns and guideways. However, the station is in recently developed neighborhood/commercial district so the impact would be moderate.

Alternative 6.3(s) (Delridge North Subsegment). Starting from Pigeon Point, this subsegment alignment alternative for the Delridge area would use a single beam configuration and would transition to a route adjacent to the south side of the West Seattle Bridge. The guideways would turn south to follow the center of SW Avalon Way. Because of existing high impact levels from the West Seattle Bridge and the Nucor Steel plant, impacts from Pigeon Point to SW Avalon Way would be low level. Along SW

Avalon Way, the guideways would pass the west side of Nucor, several businesses, and two- to five-story multi-family residences. Impact levels in this are would be expected to be moderate to low.

Delridge 3 would be a side platform station located on the south side of SW Spokane Streetwest of the intersection with Delridge Way SW. Because of existing impacts from the West Seattle Bridge, surface streets, and large-scale Nucor buildings, this station is expected to have low-level impacts to its surroundings.

Alternative 6.4 (Andover/Yancy Subsegment). This subsegment alternative for the Delridge area would cross SW Andover Street east of SW 26th Street, running about 45 feet south of SW Andover. The alignment would then turn southwest to align with the north side of SW Yancy Street, and would then take the same route as Alternative 6.1 along SW Yancy Street to SW Avalon Way. This alternative would include the Delridge 1A (26th) station, which would have moderate to high visual impacts on Longfellow Creek Greenbelt because the station and guideway would be aligned over the buffer at the intake culvert at SW Andover Street (Figure MM-14, which can be found in Appendix MM of this Final EIS). About ten mature trees would be removed for this alignment.

A single beam option on the Alternative 6.4 (**Alternative 6.4(s)**) alignment is also being considered. This alternative would not have a Delridge station. Without a Delridge Station, the impacts along SW Andover Street would be somewhat reduced from the other alternatives in the Delridge area. Where single beam alignments would be utilized in this alternative, they would reduce view blockage and diminish the bulk of the guideway for viewers looking parallel to the guideway.

Alternative 6.5 (Genesee Subsegment). This subsegment alternative for the Delridge area would turn out of the Delridge Way SW right-of-way at Delridge 4 Station near the intersection with SW Genesee Street. The alignment would then continue on the west side of Delridge Way SW, before making a broad turn west onto SW Genesee. Along Delridge Way SW, land uses include several medium scale office buildings and a number of single-family residences. Because existing impact levels from the roadway, traffic and utilities are relatively high, the addition of the guideway, along with removal of several houses, would generate moderate level impacts.

Delridge 4 Station would be located on State Department of Social and Health Services (DSHS) property on the west side of Delridge Way SW, north of the intersection with SW Dakota Street. Its height, scale, and bulk would be similar to adjacent office buildings. Light and glare from the station may be somewhat greater than that currently experienced in the adjacent area. Overall impacts from this station would be low to moderate.

On SW Genesee Street, the alignment would cross to the south side of the street, following the north edge of the grounds of the Delridge Community Center, and the West Seattle Golf Course and Recreational Center (Figure MM-15, which can be found in Appendix MM of this Final EIS). It would cross Longfellow Creek Greenbelt and ascend to meet the dual beam alignment of Alternative 6.2. Alternative 6.5 would affect visual resources along SW Genesee Street in several ways. The scale and height of the aerial would contrast with small-scale single-family houses on the north side of the street, and also with the scale of the two-lane roadway. The guideway would contrast visually with residences and with public open space on the both sides of the street. The guideway would need to be elevated approximately 90 feet to cross Longfellow Greenbelt and climb to SW Avalon Way. This would result in obstruction of east-west views along the guideway.

The guideway would also displace mature street trees along the south side of SW Genesee Street (on the grounds of the Delridge Community Center), and other mature trees in the West Seattle Golf Course and Recreational Center. The resulting level of the combined impacts of the guideway on SW Genesee Street would be high, but impacts to the golf course would be low since the guideways are high enough to not block views to the north, and no shadows would fall on the golf course. Golfers now look at homes and

midrise apartment buildings to the north of the course, and this view would be altered by the presence of the guideways.

Preferred Alternative. The Preferred Alternative for the West Seattle Segment is a combination of subsegment alternatives. : Alternative 6.1.1(s), a single beam configuration across the West Seattle Bridge past Pigeon Point to the Delridge Way SW/SW Andover Street intersection. This alignment would avoid the Pigeon Point greenbelt and therefore have significantly lower impacts than Alternative 6.1.2. The single beam option would reduce view blockage and diminish the bulk of the guideway compared to the dual beam option.

Alternative 6.3(s) with a single beam configuration is the preferred subsegment through the Delridge area, in part because it would avoid the Longfellow Creek Greenspace by passing north of the Nucor steel plant. This subsegment would use the Delridge 3 (Nucor) station alternative. Impacts from this alternative would be much lower in this area than the alternatives that would pass over or adjacent to the greenspace.

Alternative 6.2.2 with a dual beam configuration is the Preferred Alternative from the SW Avalon Way/35th Avenue SW intersection to the north side of SW Alaska Street along the center of 35th Avenue SW. The Avalon 2B station is the Preferred Station Alternative. Impacts from this center alignment and west-side station would be much less than Alternative 6.2.1 because the center alignment and station would avoid the mature tree screen in West Seattle Stadium Park. Views from inside the park would not be affected by this alignment since the trees would remain. Visual contrast between park amenities and the station would be much less than with Avalon 2A because of increased distance and visual screening between the park and station (Figure MM-13, in Appendix MM of this Final EIS).

Alternative 6.1 is the Preferred Alternative through the Alaska Junction area with the Alaska Junction 1 station. Alternative 6.1.6(s) is the Preferred Alternative for the California/Morgan Junction area with the Morgan Junction 1A station alternative. Alternative 6.1.6 (s) is a single beam alignment on the west side of California Avenue SW. The single beam option would reduce view blockage and diminish the bulk of the guideway compared to the dual beam alternatives, but would require the removal of many street trees along the west side.

4.5.2.2 No Action Alternative

Under the No Action Alternative, there would be no visual impacts related to the alignment of the proposed Green Line. Visual changes to the segments would result from increased vehicular traffic on these roads and associated development. Conversely, no new scenic views as seen from the Green Line would be created.

4.5.3 Mitigation

This section discusses potential mitigation measures that could be implemented for all alternatives. The urban design study process described below is considered to be foundation for all mitigation concepts that will be developed during the design development phase.

4.5.3.1 Operation

SMP is committed to a community design process that would determine design solutions that are appropriate and that carefully consider the preferences and requirements of community members, property owners, and stakeholders. To this end, the SMP initiated an urban design process to identify a set of guidelines that would support and inform the integration of the Monorail with the communities and city of Seattle. The Green Line's urban design team, after considerable research, community input, and various design studies, completed the "System-wide Urban Design and Landscape Study" and a suite of station and streetscape concepts (Appendix MM, which can be found in Volume Two of this Final EIS).

The System-wide Study provides urban design goals, principles, and criteria that are intended to ensure that the new monorail in the urban landscape will be a quality-of-life enhancement. The Study resulted in draft design guidelines (Appendix MM) that set standards for the Green Line to provide safe and easy access to the monorail and other transit options; be a landmark in the urban landscape; benefit each neighborhood along the monorail; and be responsive to community plans.

The Study was conducted with these assumptions in mind:

- The Green Line should reinforce and integrate the unique characteristics of Seattle and its communities with a response to form and function that is appropriate to the context
- The monorail will be experienced within the city at a full range of scales, from regional to intimate, over time. Therefore, the guidelines are structured to reflect the dynamic scale of the city context to assure design integration at all scales
- The monorail and its place in the city should be evaluated using the criteria of placemaking, environment, aesthetics and function
- The monorail is a significant piece of civic architecture

Public/private partnerships and a meaningful, sincere community involvement process are required for successful implementation of City and community long-range goals in conjunction with operation of the Green Line. The results of the community involvement process undertaken by the SMP will be incorporated into the architectural and design work for the Green Line, with the intention of mitigating impacts and enhancing community assets. The study will be used as part of the City of Seattle's review and permitting of the Monorail transit facilities. The guidelines will also be included in the DBOM package to ensure that the monorail's design and construction are responsive to community needs and plans.

Other additional actions include:

- The Monorail Review Panel, consisting of members of the City of Seattle Design and Planning Commissions and the Design Review Boards, will review and make recommendations on station and facility designs. The Panel will review plans both before they are submitted to the City of Seattle for permitting and during the development of Detailed Design Requirements.
- Facilities would be integrated with area redevelopment plans as appropriate, particularly at stations. (In the event that future projects are proposed for station areas, those projects would undergo separate environmental review as needed.)
- Source shielding would be used in exterior lighting at stations and ancillary facilities, such as maintenance bases and park-and-ride lots, to ensure that light sources (such as bulbs) are not directly visible from residential areas, streets, and highways, and to limit spillover light and glare in residential areas.
- Where practicable, existing street trees along the sidewalks will be retained, or new vegetation planted, to help soften the visual appearance of the monorail facility.
- Green Line columns and guideways would be limited in bulk to the extent possible based on sound engineering design so that shadow and scale impacts are minimized. SMP has developed Design Guidelines that are described in more detail in Chapter 5. The Design Guidelines process – in collaboration with the City – will be used to prepare and approve designs for columns, guideway, and stations. In addition, the specifications for the DBOM contractor provide for a collaborative, "over-the-shoulder" review process, including a public design hearing, to confirm the design concepts for the guideway and major structures. This review process, along with a

detailed permitting process, will determine the final designs for the guideways, columns, and stations.

4.5.4 Significant Unavoidable Adverse Impacts

The Green Line would be set in an urban context where visual change is expected, and differences in scales of structures are typical. However, the perception of some viewers may be that the visual changes associated with the Green Line in Downtown, at the Ship Canal crossing, and at the Seattle Center are significant, particularly when considered at a single location. The far west bridge alignment alternative across the Ship Canal would result in changes to the visual character of the Fishermen's Terminal area that would be perceived as significantly adverse to some viewers.

Historic resources are found throughout the corridor and the introduction of the Green Line, a modern structure, would change their setting and some views of the resources. In several areas of the city, including Pioneer Square, the Historic Resources analysis finds that there would be a significant adverse visual impact on historic resources. For a full discussion of impacts to historic resources, please refer to Section 4.11, Cultural Resources.

The City of Seattle's Downtown and Seattle Center are dynamic settings with existing structures similar to the Green Line and the overall degree of change within the context of these larger neighborhoods is typically moderate. Some viewers would perceive the visual change to Seattle Center as adverse, but other viewers would perceive the changes to be highly consistent with the character of Seattle Center, and not adverse. In the Downtown area, adverse visual effects would occur for historic resources, some views of Puget Sound would be partially obstructed. The appearance and character of Second Avenue and some of its important civic architecture, including Benaroya Hall and the Seattle Art Museum, would be significantly altered. Still, the Green Line structure would be consistent with the Downtown urban development trend that includes high density, high rise buildings and intensive transportation activity.

4.6 AIR QUALITY

4.6.1 Affected Environment

4.6.1.1 Air Quality Regulations and Standards

This section summarizes relevant air quality regulations and data on the existing air quality in the Seattle metropolitan area.

The federal government has established National Ambient Air Quality Standards (NAAQS) to protect the public from air pollution. In addition, the Washington Department of Ecology (Ecology) has established State Ambient Air Quality Standards (SAAQS), as shown in Table 4.6-1, which are at least as stringent as the NAAQS. The U.S. Environmental Protection Agency (EPA) has delegated air quality program implementation for most issues to Ecology and to the Puget Sound Clean Air Agency (Clean Air Agency).

Table 4.6-1. State and Federal Ambient Air Quality Standards

Pollutant	Averaging Time	Federal	Washington
Carbon Monoxide	8 hours	9 ppm	9 ppm
	1 hour	35 ppm	35 ppm
Lead	Calendar Quarter	1.5 $\mu g/m^3$	1.5 $\mu g/m^3$
Ozone	1 hour	0.12 ppm	0.12 ppm
	8 hours*	0.08 ppm	--
Nitrogen Dioxide	Annual Arithmetic Mean	0.053 ppm	0.05 ppm
Sulfur Dioxide	Annual Arithmetic Mean	0.03 ppm	0.02 ppm
	24 hours	0.14 ppm	0.10 ppm
	3 hours	0.5 ppm	0.5 ppm
PM_{10}	Annual Geometric Mean	50 $\mu g/m^3$	50 $\mu g/m^3$
	24-hour Average	150 $\mu g/m^3$	150 $\mu g/m^3$
$PM_{2.5}$	Average Annual Arithmetic Mean*	15 $\mu g/m^3$	--
	24-hour Average*	65 $\mu g/m^3$	

Notes: ppm = parts per million; $\mu g/m^3$ = micrograms per cubic meter; PM_{10} = particulates with an aerodynamic diameter of less than or equal to 10 micrometers; $PM_{2.5}$ = particulate with an aerodynamic diameter of less than or equal to 2.5 micrometers.

* EPA promulgated new standards for ozone and $PM_{2.5}$ in September 1997. The EPA is now in the process of implementing the new standards.

Sources: EPA Office of Air Quality Planning and Standards (OAQPS); Washington Department of Ecology, 1998 Air Quality Data Summary, April 2000.

Geographic areas in which concentrations of a pollutant exceed the ambient air quality standards are classified as nonattainment (i.e., do not attain standards) areas. Federal regulations require states to prepare State Implementation Plans (SIPs) that identify (1) emission reduction strategies for nonattainment areas and (2) maintenance strategies for areas that were in nonattainment, have improved air quality, and have been redesignated as attainment areas. Prior to 1978, the central Puget Sound region was designated as a nonattainment area for both ozone and carbon monoxide (CO). In 1996, the EPA redesignated the region as an attainment area and approved the associated air quality maintenance plans. The maintenance plans for ozone and CO include transportation-related measures. CO control measures include vehicle inspection and maintenance programs and congestion management if needed in locations with high measured CO values. Ozone control measures include a public smog awareness program to encourage voluntary changes in behavior to reduce emissions during weather conditions that could trigger

elevated ozone levels. This program is targeted at getting people to reduce use of personal vehicles, gasoline-powered lawn mowers, and products that emit volatile organic compounds (Clean Air Agency web site).

In 1987, the Seattle Duwamish industrial area was designated as a nonattainment area for particulate matter with an aerodynamic diameter of 10 micrometers or less (PM_{10}). In May 2001, this area was redesignated as an attainment area for PM_{10} and is now subject to the associated maintenance plan. The PM_{10} maintenance plan focuses primarily on industrial sources. The maintenance plan for the area, issued by the Clean Air Agency and approved by EPA, states that emissions come primarily from industrial sources (83 percent), with a minor amount of emissions from diesel exhaust (eight percent) and gasoline-fueled motor vehicles (four percent). The maintenance plan does not include emissions reductions that have resulted from EPA-required reductions in fuel sulfur content for diesel fuel in 1993 and gasoline in 2000, although both of these measures would be expected to reduce PM_{10} formation resulting from vehicle emissions (Federal Register, Volume 66, Number 49, pages 14492 to 14497). EPA is currently implementing a new federal standard for particulate matter less than or equal to 2.5 micrometers in diameter ($PM_{2.5}$). Monitoring data for several locations in the central Puget Sound region indicate that $PM_{2.5}$ levels will likely comply with EPA's new $PM_{2.5}$ 24-hour standard. However, these same data are less conclusive regarding compliance with the new annual average standard. The data indicates that motor vehicles are not the primary contributor to PM_{10} issues in the Duwamish maintenance area (Ecology, 2000-2002 Air Quality Trends Report).

WAC 173-420 and 40 CFR 93 seek a demonstration of conformance with the purpose and intent of the SIP for transportation projects. In order to maintain conformity with the air quality implementation plans, transportation projects should not (1) cause or contribute to any new violation of the NAAQS, (2) increase the frequency of any existing violation of the NAAQS, or (3) delay the timely attainment of the NAAQS. Projects are also required to come from a conforming transportation plan. The Puget Sound region is in attainment with all NAAQS; therefore, the only relevant provisions of WAC 173-420 for the project are not to cause or contribute to a new NAAQS violation and to come from a conforming transportation plan. The demonstration of not contributing to a new NAAQS violation is considered to be met if it is shown that the CO NAAQS will not be exceeded at intersections affected by the project.

Clean Air Agency Regulation I, Articles 5 and 6 require certain types of stationary sources and stationary sources with emissions above certain thresholds to obtain a permit to operate, or to register emissions (refer to Section 4.6.2.1 for additional information on how the determination is made). These regulations may apply to the Green Line Operations Center or to stations. These regulations are designed to prevent significant air quality impacts from stationary sources.

4.6.1.2 Existing Conditions

The Seattle area is currently a designated attainment area for all pollutants. Over the past decade, air quality in the Seattle area has improved even while traffic congestion and vehicle miles traveled (VMT) have increased (Ecology and Clean Air Agency web sites). The main pollutants of concern for transportation projects in the Seattle area such as the Green Line are CO and ozone. Particulate matter is also a concern. The most recently published, fully validated air quality data for the Puget Sound region covers 1999 through 2001. The Clean Air Agency currently prepares an air quality summary every three years. Although the data have not been fully validated, data collected since 2001 support the same conclusions presented for the 1999 to 2001 period.

- **Carbon Monoxide.** CO forms when the carbon in fuels does not burn completely. Higher levels of CO generally occur in areas with high traffic congestion levels during stagnant winter weather conditions. Vehicle emissions are the primary source of CO in the Puget Sound region. Ecology

maintains CO monitoring stations in areas with high traffic congestion levels, including central business areas, roadsides, and shopping malls.

The Puget Sound airshed was in compliance with the 8-hour CO standard for the years 1999 to 2001. Maximum concentrations for CO ranged from 2.8 to 7.5 ppm, well below the 8-hour standard of 9 ppm. Because measured 1-hour concentrations are historically much lower than the 35 ppm standard, 1-hour CO trends were not tracked. Maximum and second highest measured 1-hour CO were 16.1 and 15.6 ppm in 1999, 10.5 and 8.6 ppm in 2000, and 9.5 and 8.8 ppm in 2001 (Clean Air Agency, 1999-2001 Air Quality Data Summary).

Based on discussions with the Clean Air Agency, dispersion modeling was performed at three intersections that could potentially be affected by the Green Line alternative alignments. The results of the modeling analysis document that existing CO concentrations are below both the NAAQS 8-hour and the 1-hour CO air quality impact criteria for these intersections.

- **Ozone.** Ozone issues tend to be regional in nature because the chemical reactions that produce ozone occur over a period of time. Volatile organic compounds (VOCs) and nitrogen oxides (NO_x) react with sunlight to produce ozone. High ozone levels occur during summer. Vehicle emissions are the primary source of VOCs and NO_x in the Puget Sound region (Clean Air Agency web site). Seattle currently has a maintenance program in place to maintain compliance with the NAAQS.

  According to the data for 1999 to 2001, the Puget Sound air basin maintained attainment for ozone. This means the three-year average of the fourth-highest 8-hour concentration never exceeded the NAAQS. Because of how the ozone standard is defined, the three highest concentrations can exceed the level of the standard while still maintaining attainment. In 1999, the highest 8-hour concentration at Enumclaw (0.090 parts per million [ppm]) exceeded the level of the standard; in 2000, the highest and second-highest concentrations exceeded this level. The majority of monitoring stations measuring ozone are located in rural areas of Puget Sound. In the Puget Sound region, the hot sunny days favorable for ozone formation are typified by light north-to-northwest winds. By the time the highest concentration of ozone has formed in the afternoon and early evening, it has been transported 10 to 30 miles from the original source. Consequently, the highest concentrations of ozone in the Puget Sound region are measured in areas such as North Bend, Enumclaw, and Eatonville. Regional trends show a flat ozone level or a slight decrease over the 1999 to 2001 period (Clean Air Agency web site).

- **PM_{10}.** PM_{10} includes both solid and aerosol particles suspended in the air. The Puget Sound airshed was in compliance with both the annual and 24-hour standards for PM_{10} for the years 1999 through 2001. No monitored values exceeded the annual standard of 50 micrograms per cubic meter ($\mu g/m^3$) or the 24-hour standard of 150 $\mu g/m^3$. Annual PM_{10} trends have flattened since 1998 and are well below the 50 $\mu g/m^3$ standard. In the Duwamish PM_{10} maintenance area in south Seattle, the maximum 24-hour PM_{10} concentration has remained relatively flat since 1998 at a level of 80 $\mu g/m^3$, well below the 150 $\mu g/m^3$ standard (Clean Air Agency web site).

- **$PM_{2.5}$.** The Puget Sound airshed was in compliance with both standards for $PM_{2.5}$ for the years 1999 through 2001. The annual standard of 15 $\mu g/m^3$ was not exceeded at any of Ecology's monitoring stations. Although the highest $PM_{2.5}$ concentration measured in 2000 (70 $\mu g/m^3$) exceeded the standard, it did not violate the standard. Because of the way the daily $PM_{2.5}$ standard is defined, the three-year average of the 98th percentile of daily concentrations must not exceed 65 $\mu g/m^3$. In 2000, the 98th percentile was 49 $\mu g/m^3$ (second highest concentration) and was the highest 98th percentile of $PM_{2.5}$ measured in the Puget Sound region in 1999 through 2001. For the 1999 to 2001 period, concentration trends for $PM_{2.5}$ were flat at the 98th percentile of daily levels of 30 to 50 $\mu g/m^3$ and annual daily levels of 10 to 12 $\mu g/m^3$. The long-term trend indicates a gradual downward tendency in $PM_{2.5}$ concentrations (Clean Air Agency web site).

- **Air Toxics.** The Clean Air Agency has prepared a Draft Puget Sound Air Toxics Evaluation that identifies diesel particulate matter (diesel soot) as the primary contributor to cancer risk in the Puget Sound region. Wood smoke, and other mobile source related toxics were also identified as contributors to potential cancer risk (see Section 4.17, Construction, for discussion of air toxics emissions from construction vehicles).

4.6.2 Impacts

4.6.2.1 Operational Impacts

This section summarizes the air quality impacts that could result from operation of the Green Line. Emissions sources potentially associated with the Green Line are the monorail itself, stationary sources such as the Operations Center and stations, and increased emissions or concentrations as a result of changes to traffic patterns. This section also summarizes the Green Line's compliance with the Washington SIP.

The Green Line itself will be powered by electricity and would not have combustion-related emissions. Any of the Green Line alternative alignments under consideration would likely reduce regional vehicle miles traveled (VMT). This could reduce regional vehicles emissions on a long-term basis and could provide an overall, long-term air quality benefit as a result. In addition, all of the Green Line alternative alignments would offer an alternative transportation mode to the public during air quality alert conditions. There is no significant difference in the VMT reduction among alternatives.

An estimate of the typical weekday regional pollutant emissions was made and is shown in Table 4.6-2. When compared to the No Action Alternative, the Green Line is projected to reduce regional Volatile Organic Compound (VOC) emissions by approximately 120 pounds per day, and regional NO_x emissions by approximately 130 pounds per day. Any reduction in VOC and NO_x emissions assists the Puget Sound region's strategy to remain in attainment for ground level ozone (smog). Air pollutant emissions reductions between any of the Green Line alternatives and the No Action alternative also occur for CO (550 pounds per day).

Table 4.6-2. Estimated Typical Weekday[a] Regional Pollutant Emissions (pounds/day)

Alternative	Daily VMT[b]	VOC	CO	NO_x
Existing Conditions	3,409,100	14,530	124,680	17,860
No Action	3,978,300	11,060	50,710	12,090
Green Line	3,935,800	10,940	50,160	11,960

Notes: VMT = Vehicle miles traveled; VOC = Volatile organic compounds; CO = carbon monoxide; NO_x = nitrogen oxides

[a] Year 2020, except Existing Conditions are year 2003 data. Estimates based on a 30 mile per hour regional speed assumption – this will likely somewhat underestimate emissions reductions resulting from implementation of the Green Line.

[b] Refer to Section 4.1, Transportation.

The Project has also been regionally modeled by the Puget Sound Regional Council (PSRC), a positive air quality finding has been made, and conformity with State and Federal air quality standards has been determined. The Project has been included in the 2004-2006 Regional Transportation Improvement Plan (TIP), which has been approved by FHWA and FTA. The Green Line itself is not a source of particulates and would not cause or contribute to any new violations of the PM_{10} NAAQS.

The Green Line Operations Center and some stations may have sources of pollutants such as combustion sources for heating. If these stationary sources have certain types of equipment or emit more than certain

thresholds of pollutants, they will be subject to requirements to register, or to obtain an authority to operate from the Clean Air Agency. Clean Air Agency regulations for stationary sources are designed to prevent significant air quality impacts.

To assess the potential impacts of changes to traffic patterns, the operating conditions of the Green Line were modeled to determine whether any of the alternatives could cause long-term localized air impacts. The analysis determined that the Green Line is not expected to cause local hot spots. All of the Green Line alternative alignments would have the potential to result in long-term localized air quality impacts if, as a result of the project, local congestion at intersections increases to a point where the CO NAAQS is exceeded. Because of improvements in emission reduction technology for vehicles and the vehicle maintenance and inspections programs used to reduce vehicle emissions in the Puget Sound area, local hot spots (intersections with CO levels that exceed the CO NAAQS) have not been observed to occur in the last few years (see discussion of CO levels in the Existing Conditions section) and are not expected as a result of the Green Line. This finding was verified with a dispersion analysis that was performed at three intersections. The analysis of local impacts at intersections included the traffic expected to be generated at Green Line stations.

To select the three intersections for analysis, intersections potentially affected by the project were ranked by total entering volume and level of service (LOS) (see Section 4.1, Transportation, Tables 4.1-20 and 4.1-21 – Ballard Segment; Tables 4.1-27 and 4.1-28 – Interbay Segment; Table 4.1-34 – Queen Anne/Seattle Center/Belltown Segment; Table 4.1-40 – Downtown Segment; Table 4.1-45 – SODO Segment; and Table 4.1-50 – West Seattle Segment).

Intersections that are stop-sign controlled generally do not have sufficient traffic volumes to cause air quality impacts. At intersections with higher traffic volumes and congestion levels (poor LOS), it is more likely that pollutant concentrations adjacent to the intersection could exceed the CO NAAQS. Therefore, the signalized intersections affected by the project and projected to operate at LOS D, E, or F were selected as a subset with potential air quality impacts. The three intersections analyzed were selected from the subset with potential air quality impacts as follows: (1) **15th Avenue NW/NW Market Street (Alternative 1.2 [Market 2]),** the intersection with the highest entering volume and the third worst LOS; (2) **Fourth Avenue S/S Royal Brougham Way (all alternatives),** the intersection with the worst LOS and delay; and (3) **California Avenue SW/SW Morgan Street/Fauntleroy Way SW (Alternative 6.1 [Morgan Junction 1]),** the intersection with the worst LOS and delay in the West Seattle Segment to address geographic distribution of potential project impacts. These intersections are expected to result in the highest projected CO concentrations as a result of the Green Line because they have the combined worst performance and highest traffic volumes. For each intersection, the Green Line alternative with the highest traffic volume and worst delay was selected and only that alternative was analyzed in detail. Since the alternative with the worst projected operating conditions was not projected to cause an air quality impact, none of the other alternatives including the Preferred Alternative would be expected to cause an air quality impact.

The highest CO concentration modeled at each intersection is identified in Tables 4.6-3 and 4.6-4. Both 1-hour and 8-hour CO concentrations were estimated. The three intersections selected are expected to result in the worst increases in pollutant concentrations as a result of any Green Line alignment alternatives including the Preferred Alternative, and no exceedances of the CO NAAQS are projected at these intersections. Therefore, no exceedances of the CO NAAQS are expected at any intersection as a result of the project. None of the Green Line alternative alignments are expected to cause long-term adverse air quality impacts and the Green Line would not cause or contribute to a violation of the NAAQS. Air quality impacts are not a significant consideration in selecting among Green Line alternative alignments.

Table 4.6-3. Highest Projected 1-Hour Carbon Monoxide Concentrations Near Intersections (ppm)

		2010		2020	
	Existing	No Action	Action	No Action	Action
15th Avenue NW/NW Market Street [a]	9	7	7	5	6
Fourth Avenue S/S Royal Brougham Way [b]	10	8	8	7	7
California Avenue SW/SW Morgan Street/ Fauntleroy Way SW [c]	7	5	5	5	5

[a] Ballard Segment intersection.
[b] SODO Segment intersection.
[c] West Seattle Segment intersection.

Table 4.6-4. Highest Projected 8-Hour Carbon Monoxide Concentrations Near Intersections (ppm)

		2010		2020	
	Existing	No Action	Action	No Action	Action
15th Avenue NW/NW Market Street [a]	7	5	5	4	4
Fourth Avenue S/S Royal Brougham Way [b]	7	6	6	5	5
California Avenue SW/SW Morgan Street/ Fauntleroy Way SW [c]	5	4	4	3	3

[a] Ballard Segment intersection.
[b] SODO Segment intersection.
[c] West Seattle Segment intersection.

4.6.2.2 Impacts of the No Action Alternative

Tables 4.6-3 and 4.6-4 list the results of the intersection hot spots analysis. The CO hot spots modeling results for the No Action Alternative show that no intersections included in the analysis would cause an exceedance of the NAAQS or SAAQS in 2010 or in 2020. With the No Action Alternative, there would be no project-related sources of emissions and no reductions in projected VMT.

4.6.3 Mitigation

All of the Green Line alternative alignments including the Preferred Alternative could be expected to decrease regional VMT and associated regional emissions and would likely have a positive impact on regional air quality. None of the alternatives would be expected to cause or contribute to any local exceedance of the NAAQS. No adverse air quality impacts are expected as a result of the project, and no mitigation is needed.

The intersections and alternatives selected for the hot spots analysis represent the worst projected operating conditions and therefore the worst air quality impacts. For the 15th Avenue NW/NW Market Street intersection Alternative 1.2 was analyzed. Operation of the Ballard Preferred Alternative 1.1(s) for this intersection is projected to have lower delay than Alternative 1.2. This would result in lower air quality impacts for the Preferred Alternative. The analysis of Fourth Avenue S/S Royal Brougham Way is representative of all alternatives, including the Preferred Alternative. For the California Avenue SW/SW Morgan Street/Fauntleroy Way SW intersection, Alternative 6.1 was analyzed. Operation of the West Seattle Preferred Alternative 6.1.6(s) for this intersection is projected to have lower delay than Alternative 6.1. This would result in lower air quality impacts for the Preferred Alternative.

4.6.4 Significant Unavoidable Adverse Impacts

No significant unavoidable adverse air quality impacts are expected as a result of any of the Green Line alternatives or the No Action Alternative.

4.7 NOISE AND VIBRATION

This section summarizes the noise and vibration impact analysis in support of the environmental review of the proposed Green Line. Technical details of this analysis are presented in Appendix R, Noise and Vibration Backup Information in the Draft EIS.

4.7.1 Affected Environment

4.7.1.1 Introduction to Noise Terminology and Descriptors

The human ear responds to a wide range of sound intensities. The decibel (dB) scale used to describe sound is a logarithmic rating system that accounts for the large differences in audible sound intensities. Using this scale, humans perceive an increase of 10 dB as a doubling of loudness; for example, a 70 dB noise level sounds twice as loud as a 60 dB noise level. Under ideal listening conditions, people generally cannot detect differences of 1 dB, while differences of 2 or 3 dB can usually be detected by people with normal hearing. In the outside environment, and especially near complex noise sources such as roads, sound level changes of 2 or 3 dB might not be noticeable to most people, while a 5 dB change would likely be perceived as a clear and noticeable change.

Because of the logarithmic scale used to describe noise, a doubling of a noise source strength (e.g., twice as much traffic on a road) produces a 3 dB increase in average roadway noise. Such an increase would not be perceived as a doubling in noise loudness, which requires a 10 dB increase. Sound levels caused by line sources (e.g., relatively long, variable, or moving sound sources) such as traffic decrease at a rate of 3 to 4.5 dB when the distance from the road is doubled, depending on the type of surface between the source and the receiving property (e.g., hard or soft). Sounds from discrete events or stationary point sources, such as an idling bus, decrease by 6 dB when the distance from the source is doubled. Conversely, halving the distance to a source increases sound levels by 3 dB and 6 dB for roadway and point sources, respectively.

When addressing the effects of noise on people, one must consider the frequency response of the human ear, or those sounds that people hear best. To address the frequency response, instruments that measure sounds are designed to weight measured sound levels based on emphasizing the frequencies people hear best, and de-emphasizing those frequencies people do not hear as well. The frequency weighting most often used to evaluate environmental noise is A-weighting, and measurements from instruments using this system are reported in A-weighted decibels or dBA. All sound levels in this evaluation are reported in A-weighted decibels.

For a given noise source, factors affecting the sound transmission from the source and the potential related noise impact include distance from the source, frequency of the sound, absorbency of the ground surface, the presence or absence of obstructions and their absorbency or reflectivity, and the duration of the sound. The degree of impact on humans may also depend on existing sound levels. For example, if existing sound levels are high, introducing a new noise source tends to have less impact than in an environment where background noise levels are low. Typical sound levels of some familiar noise sources and activities are presented in Table 4.7-1.

Many regulatory agencies use the equivalent sound level (Leq) to evaluate noise impacts. The equivalent sound level is the level of a constant sound that has the same sound energy as the actual fluctuating sound. As such, the Leq can be considered an energy-average sound level. But this noise metric should not be confused with a simple arithmetic average that may under-represent high and low values; an Leq tends to emphasize louder sound levels because they contain more sound energy than lower levels. And the Leq

has been found to be highly correlated to community perceptions of noise and to the potential for annoyance from noisy activities. When referring to sound levels, it is important to identify the time period being considered, with $L_{eq(24)}$, for example, being the equivalent sound level for a 24-hour period. The day-night sound level (L_{dn}) is similar to an $L_{eq(24)}$, except that the calculation involves adding 10 dBA to sound levels measured between 10:00 p.m. and 7:00 a.m. to account for potential sleep interference.

Table 4.7-1. Sound Levels Produced by Common Noise Sources

Thresholds/ Noise Sources	Sound Level (dBA)	Subjective Evaluations [a]	Possible Effects on Humans [a]
Human Threshold of Pain Carrier jet takeoff at 50 feet	140	Deafening	Continuous exposure to levels above 70 dBA can cause hearing loss in the majority of the population
Siren at 100 feet Loud rock band	130		
Jet takeoff at 200 feet Auto horn at 3 feet	120		
Chain saw Noisy snowmobile	110		
Lawn mower at 3 feet Noisy motorcycle at 50 feet	100	Very Loud	
Heavy truck *maximum* at 50 feet City bus *maximum* at 50 feet	90		
Aerial Rail Transit @ 50 mph at 50 feet Busy urban street, daytime	80	Loud	
Idling Bus @ 50 feet Monorail @ 40 mph at 50 feet	70		Speech interference
Air conditioning unit at 20 feet Conversation at 3 feet	60	Moderate	
Quiet residential area Light auto traffic at 100 feet	50		Sleep interference
Library Quiet home	40	Faint	
Soft whisper at 15 feet	30		
Slight rustling of leaves	20	Very Faint	
Broadcasting Studio	10		
Threshold of Human Hearing	0		

[a] Note that both the subjective evaluations and the physiological responses are continuums without true threshold boundaries. Consequently, there are overlaps among categories of response that depend on the sensitivity of the noise receivers.

Source: EPA (1974) and others.

4.7.1.2 Operational Impacts: Methods of Noise Analysis

Green Line Train Noise Modeling

The Green Line operational noise impact assessment was conducted using the Federal Highway Administration (FHWA) Traffic Noise Model (TNM v. 2.1 - USDOT 2003). This tool is the latest available computer model developed by FHWA for assessing noise from line sources such as roads.

Using this tool, noise from the Green Line was estimated based on monorail trains running on elevated guideways along the alternative alignments. This approach was developed based on source-specific sound level measurements of a Bombardier Mark VI monorail in use at Walt Disney World in Orlando, Florida. This modeling used varying numbers of light-duty vehicles to simulate the operation of the Green Line at projected varying travel speeds along the alignment alternatives (excluding SODO, where there are no sensitive receivers).

The Traffic Noise Model (TNM) calculates hourly L_{eqs} due to line sources and can consider effects of terrain, the presence of obstacles that can impede sound transmission, and the effects of varying ground types between the source and the receptors. In this instance, the model was used to estimate noise from the Green Line by considering one train traveling in each direction at the average speed in a number of subsections of each alternative Green Line segment. Model results were then scaled up to represent the number of trains expected in each hour of the day. This number was then converted to an L_{dn} (a 24-hour sound level) that could be compared with both existing sound levels (Table 4.7-5) and with Federal Transit Administration (FTA) impact thresholds (Table 4.7-3). Refer to Appendix R, Noise and Vibration Backup Information in the Draft EIS, for additional information regarding this modeling and the source sound measurements.

After completion of the Draft EIS, the Green Line alternatives were refined and modified in response to comments and a Preferred Alternative was recommended. The entire alignment of the Preferred Alternative except the SODO Segment was subsequently evaluated with TNM modeling. The important details of this aspect of the analysis are described below.

In addition to considering the Preferred Alternative, some aspects of modeling for the Draft EIS were modified to reflect alternative modifications and refinements in the several portions of the Green Line segments that were made after completion of the Draft EIS in response to comments. These changes included both slight modifications to some segments of the previously considered alignments, as well as one new alignment alternative in the Delridge area of West Seattle. Results of all such changes are described in the following sections.

Model Receptors

The noise impact modeling examined the five segments of the Green Line alignment alternatives that include residential uses, and so did not consider the SODO Segment. Each segment of the Green Line was further subdivided into smaller sections to consider changes in expected travel speeds along each section. The noise modeling used series of theoretical receptors to represent sensitive receiving locations in each segment. Model receptors were placed to represent three general locations relative to the Green Line guideway as follows: (1) residential locations at the backside of the sidewalk, (2) residential uses set further back from the sidewalk, and (3) second row setback residential properties (i.e., homes at least one-half block from the nearest major road or guideway). Receptor locations were established based primarily on the presence of residential uses and were located as needed on both sides of the guideway. In some cases, additional non-residential-use receptors were employed to examine the potential noise implications in parks and in commercial areas of the various alignments. Receptor locations were held constant with all alternatives to enable comparison of the potential noise implications of the alternative alignments.

The TNM assessment of the Preferred Alternative used the same modeling receptors considered in the previous evaluation, and added new receptors in several areas where it was necessary to refine the analysis. In addition, the modeling of the Preferred Alternative was modified in two important ways compared with the previous modeling. First, the modeling of the Preferred Alternative considered the modified peak and non-peak monorail headways expected to occur with the single-beam configuration. Secondly, the latest modeling used a refined speed profile representing the expected operation of the

Preferred Alternative configuration. To accommodate the greater resolution of the speed profile, the five corridor segments evaluated with modeling were considered in smaller subsections than were used in the previous modeling. This change is reflected in some tables reporting the results of the impact analysis, and the differences in the Draft EIS and Final EIS analysis assumptions are explained below.

The noise impact modeling performed for the Draft EIS assumed the entire Green Line alignment would be a dual beam configuration, and used the vehicle headway and speed profiles associated with that configuration. The headways were assumed to be 4 minutes during the peak travel periods and 8 minutes during non-peak hours. This resulted in a total of 375 train trips per day across the system. In contrast, the noise modeling for the Preferred Alternative conducted for the Final EIS used single beam configurations in several areas along with revised assumptions regarding train headways along different sections of the Green Line. Downtown, headways were assumed to be 2.75 minutes during peak-period travel, four minutes during a midday rush, and eight minutes in off-peak hours. Outside the Downtown area, headways were assumed to be 5.5 minutes during the morning and evening peaks, and eight minutes in all off-peak hours. These assumptions resulted in a total of 487 trips daily across the Downtown system, and 326 trips per day across the system outside the Downtown.

The Draft EIS modeling used a speed profile developed for the ".1" alignments (those designed with a ".1" in their description in the Draft EIS), and applied these assumed speeds to all alternatives. To simplify the analysis, the speed profile was applied to relatively large sections of the Green Line alternatives, and the modeling did not consider slowing in the vicinity of stations. In contrast, the Final EIS modeling for the Preferred Alternative used a new and more refined speed profile developed for this alternative, and the modeling applied this information with greater resolution, including some slowing (but not stopping) at stations and switches. The combination of the revised headway and speed assumptions means the noise modeling for the Preferred Alternative is the most accurate to date, but it also means that it is not precisely comparable to the results of the earlier modeling. While all the analyses represent a conservative analysis based on conservative assumptions, the non-Preferred Alternative analysis was slightly more conservative and presents slightly greater impacts as a result. The more refined modeling conducted for the Final EIS is more accurate than the previous analysis, which was necessarily somewhat less detailed because of the number of alternatives that were considered. The most recent analysis is the most complete and realistic to date.

4.7.1.3 Regulatory Overview

The noise impact analysis employed the noise impact criteria developed by the FTA because these criteria are widely used to analyze noise from transit projects. These criteria are explained in the text below and illustrated in Tables 4.7-2 and 4.7-3.

Federal Transit Administration Noise Criteria

The FTA describes its noise impact criteria for transit projects in the manual entitled *Transit Noise and Vibration Impact Assessment* (FTA 1995). These criteria apply to rail projects, including monorails; fixed facilities such as transit stations, maintenance facilities, and park and ride lots; and buses traveling on local roads or in bus-only highway lanes.

FTA transit noise impact criteria are based on the land use category of the receiving properties (Table 4.7-2). The criteria for lands with sensitive nighttime uses (i.e., sleeping) are based on the day-night sound level (L_{dn}). Criteria for lands with uses confined primarily to daytime activities are based on the hourly L_{eq} of the noisiest hour of transit-related activity, especially during periods of increased sensitivity to noise. FTA noise criteria apply based on the uses of the affected properties, and apply more stringent definitions of impact for residential uses and locations where quiet is the basis for use. Less stringent

limits pertain to commercial and other institutional uses that typically do not involve nighttime uses for sleeping.

Table 4.7-2. Land Use Categories and Metrics for Transit Noise Impact Criteria

Land Use Category	Noise Metric (dBA)	Description of Land Use Category
1	Outdoor Leq(1) [a]	Tracts of land where quiet is an essential element in their intended purpose. This category includes lands set aside for serenity and quiet, and such land uses as outdoor amphitheaters and concert pavilions, as well as National Historic Landmarks with significant outdoor use.
2	Outdoor Ldn	Residences and buildings where people normally sleep. This category includes homes, hospitals, and hotels, where a nighttime sensitivity to noise is assumed to be of utmost importance.
3	Outdoor Leq(1) [a]	Institutional land uses with primarily daytime and evening use. This category includes schools, libraries, and churches, where it is important to avoid interference with such activities as speech, meditation, and concentration on reading material. Buildings with interior spaces where quiet is important, such as medical offices, conference rooms, recording studios, and concert halls fall into this category, as do places for meditation or study associated with cemeteries, monuments, and museums. Certain historical sites, parks, and recreational facilities are also included.

[a] Equivalent sound level of the noisiest hour of transit-related activity during period of noise sensitivity.

Source: FTA (1995).

FTA noise impact criteria consider both the overall sound levels and the sound level increases that would occur due to a transit project. A simple way to summarize these impact criteria is by comparing noise that would be caused by a project with existing sound levels. Figure 4.7-1 provides a graphic representation of the FTA impact criteria; the specific *impact* and *severe* threshold levels used by FTA are listed in Table 4.7-3. Under these criteria, receiving locations with low existing sound levels can be exposed to relatively more project noise before an impact occurs. Conversely, the relative allowed levels of project-related noise are lower in locations with higher existing sound levels. For example, a residential location with an existing 40 dBA Ldn would not be considered severely impacted unless project noise would be 15 dBA or more higher than existing, but a location with a 60 dBA Ldn baseline would be considered severely impacted by a project-related noise level only 3 dBA higher than existing (63 dBA).

The FTA noise policy provided the main criteria used in assessing the potential for impacts from the Green Line. The assessment for receptors representing residential receivers was based on measured and calculated Ldns (24-hour Leqs with an added nighttime noise weighting) because such locations are used for sleeping. The assessment for parks and commercial receptors was based on the highest measured and calculated hourly Leq.

While the FTA impact criteria shown in Figure 4.7-1 and Table 4.7-3 use the terms *impact* and *severe* to describe the impact thresholds, the relative significance of impacts under these criteria is not specifically defined by FTA. As shown in Figure 4.7-1, the FTA noise impact criteria are delineated by two curves that allow increasing project noise levels as existing noise increases, up to a point. Beyond that point, impact is determined based on the project noise alone. Below the lower curve in Figure 4.7-1, a project is considered to have no noise impact because on average, the project noise will result in an insignificant increase in the number of people highly annoyed by the new noise. The curve defining impact stops at 65 dBA for Category 1 and 2 land uses (parks and residences) because a number of federal agencies consider 65 dBA as the noise limit for an acceptable living environment. Project noise levels above the upper

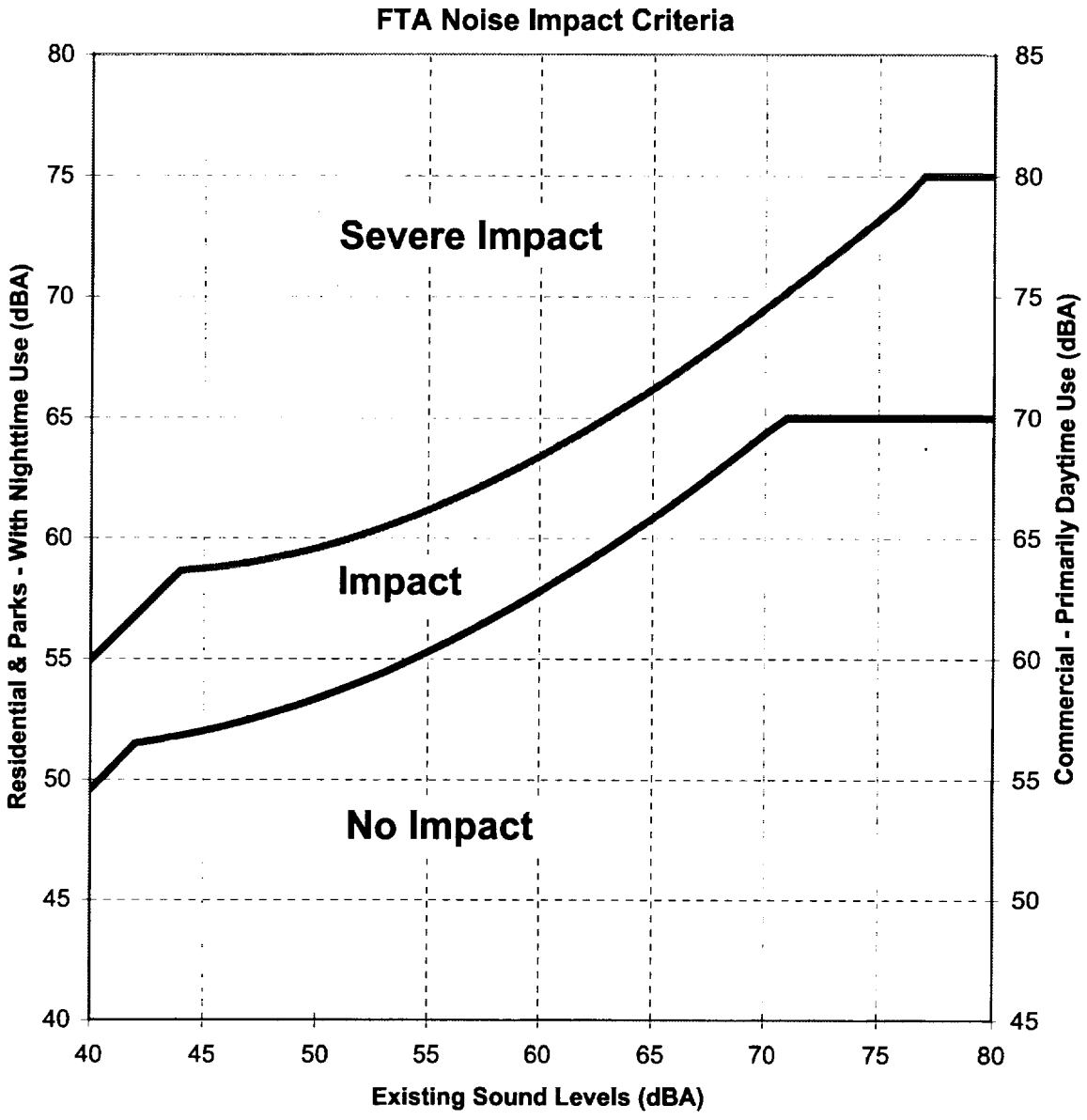


Figure 4.7-1
FTA Noise Impact Criteria

Table 4.7-3. FTA Impact Thresholds for Transit Projects (dBA)

Existing Ldn or Leq	Project-Generated Noise Levels			
	Residential and Other Sensitive Receivers		Commercial Receivers	
	Impact	Severe	Impact	Severe
< 43	Ambient +10	Ambient +15	Ambient +15	Ambient +20
43	52	58	57	63
44	52	58	57	63
45	52	58	57	63
46	53	59	58	64
47	53	59	58	64
48	53	59	58	64
49	54	59	59	64
50	54	59	59	64
51	54	60	59	65
52	55	60	60	65
53	55	60	60	65
54	55	61	60	66
55	56	61	61	66
56	56	62	61	67
57	57	62	62	67
58	57	62	62	67
59	58	63	63	68
60	58	63	63	68
61	59	64	64	69
62	59	64	64	69
63	60	65	65	70
64	61	65	66	71
65	61	66	66	71
66	62	67	67	72
67	63	67	68	72
68	63	68	68	73
69	64	69	69	74
70	65	69	70	74
71	66	70	71	75
72	66	71	71	76
73	66	71	71	76
74	66	72	71	77
75	66	73	71	78
76	66	74	71	79
77	66	74	71	79
> 77	66	75	71	80

Source: FTA (1995) - Table 3-1.

curve in this figure are considered a severe impact because a significant percentage of people would likely be highly annoyed by the new noise. A project noise level between the two curves is an impact under FTA policy, and although not considered severe, may also be significant. Noise in this range would be expected to be noticeable to most people, but may not be sufficient to cause strong adverse reactions from the community. In this transitional area, other factors must be considered to determine the magnitude of the impact and the need for mitigation. These factors include the predicted noise increase over existing levels and the types and numbers of noise-sensitive land uses that would be affected.

Under FTA criteria, locations with high existing sound levels are not considered affected by the introduction of a new noise source that would not increase the existing level more than minimally. For example, at locations where the existing sound level is 10 dBA or more louder than the noise from the Green Line, the existing level would be unaffected by the addition of the new noise. In locations where the difference in levels is less than 10 dBA, the two noise levels would combine to increase the overall level, possibly to the point of being considered an impact. In locations where the level from a new noise source is the same as existing noise, the overall sound levels would increase by 3 dBA. Under FTA criteria, the determination of impact is based on the overall sound level that would result from the addition of the new noise, and whether that level rises to a level considered an impact. So in some instances where the Green Line noise would be less than existing sound levels, the effect of combining the two levels could increase the overall sound level into the impact range.

The Green Line noise impact analysis used the FTA criteria as the primary basis for assessing the relative significance of noise related to the proposed project alternatives and defined impacts as follows. All potential impacts to non-residential use properties are considered *moderate* impacts because of the temporary exposure for most people using such facilities and the fact that sleep disturbance would not be an issue. Green Line generated sound levels affecting residential uses in areas where the resulting sound levels would remain less than about 65 dBA L_{dn} also are considered moderate impacts. In areas where existing sound levels are near or above 65 dBA L_{dn}, and where project noise would increase the level more than about 0.5 dBA, and in locations where Green Line noise would cause the cumulative noise level to approach, reach, or exceed 65 dBA L_{dn} are considered to have *potential significant impacts*. These terms are used in the following tables and discussions because they are consistent with SEPA designations of the relative significance of potential environmental impacts.

A fairly conservative (i.e., protective) approach was used in assessing the relative significance of potential noise impacts from the Green Line so as to err on the side of caution when identifying potential adversely affected residential locations. It is worth noting that FTA noise impact criteria are based on levels of noise at outdoor locations, with the assumption that indoor levels will be substantially lower, and therefore suitable for habitation, because of the sound reduction provided by building envelopes. It would likely be possible to provide acceptable indoor sound levels even if outdoor levels are too high by adding to the noise-attenuating properties of the building in question. For example, the use of better windows and/or air conditioning can substantially reduce indoor sound levels caused by outdoor sources, and may be used as a form of mitigation.

City of Seattle Noise Limits

Noise from construction of the Green Line would be governed by the timing restrictions and the noise limits included in the Seattle noise ordinance (Seattle Municipal Code, Chapter 25.08). This ordinance includes maximum permissible sound levels based on the zoning of the source and receiving properties (upper portion of Table 4.7-4). With these limits as a basis, the ordinance also sets maximum levels and durations of allowable daytime construction noise. The Seattle construction noise limits are displayed in the lower portion of Table 4.7-4.

Table 4.7-4. Seattle Maximum Permissible Levels and Construction Noise Limits (dBA)

Zoning District of Noise Source [25.08.410 & 420]	Zoning District of Receiving Property		
	Residential Day/Night	Commercial	Industrial
Residential	55/45	57	60
Commercial	57/47	60	65
Industrial	60/50	65	70
Daytime Construction Noise Limits - at 50 feet or a real property line, whichever is greater. *Construction noise is limited to the higher levels listed below, during daytime hours only, defined as 7:00 a.m. to 10:00 p.m. weekdays and 9:00a.m. to 10:00 p.m. weekends. These limits effectively prohibit construction at night except in special cases.*			
On-site sources, including dozers, loaders, power shovels, cranes, derricks, graders, off-highway trucks, ditchers, and pneumatic equipment (maximum + 25) [25.08.425 A.1]			
Residential	80	82	85
Commercial	82	85	90
Industrial	85	90	95
Portable equipment used in temporary locations in support of construction, including chain saws, log chippers, and powered hand tools (maximum + 20) [25.08.425 A.2]			
Residential	75	77	80
Commercial	77	80	85
Industrial	80	85	90
Impact types of equipment, including pavement breakers, pile drivers, jackhammers, sand-blasting tools, or other impulse noise sources, may exceed maximum permissible limits between 8:00 a.m. and 5:00 p.m. weekdays and 9:00 a.m. and 5:00 p.m. weekends, but may not exceed the following limits [25.08.425 B]:			
Leq(1 hr) - 90 dBA	Leq(30 minutes) - 93 dBA	Leq(15 minutes) - 96 dBA	Leq(7.5 minutes) - 99 dBA

Source: Seattle Municipal Code - 25.08 - Specific sections indicated.

Section 25.08.425C of the Seattle Municipal Code also prohibits construction noise generated in a commercial district from exceeding the maximum permissible sound levels in Table 4.7-4 in the interior of buildings in commercial districts between the hours of 8:00 a.m. and 5:00 p.m. Compliance with this requirement is intended to be assessed after every reasonable effort, including but not limited to closing windows and doors, has been taken to reduce such noise in the interior space.

Noise from operation of transportation sources is typically exempt from the property-line noise limit provisions of most noise ordinances, which measure the noise from a source property in a particular zone (residential, commercial, or industrial) within a receiving property that may be in another zone. Instead, transportation noise is typically controlled with specific limits using performance standards for levels from new vehicles that can be reasonably met by automobile, bus, and motorcycle manufacturers. The Seattle noise ordinance uses this approach and adopts specific standards for most transportation sources such as new cars, buses, and motorcycles. However, the Seattle ordinance does not have performance standards specific to rail uses such as trolleys, light rail, or monorail. Therefore, the more typically applicable FTA noise impact criteria have been used in this analysis because those criteria provide objective and nationally recognized standards for assessment of impacts for transit projects.

4.7.1.4 Existing Acoustic Environment

The character of the existing acoustic environment in and near the project corridor was assessed with a series of sound level measurements (SLMs) at locations representing sensitive receivers. These 24-hour

measurements document the range of sound levels that occurred over the course of the day of the measurements, and so provide an indication of typical levels in areas that could be affected by monorail noise. All measurements were taken using Type 1 sound level equipment that had been factory certified within the previous 12 months. The SLMs are summarized in Table 4.7-5, and the measurement locations are depicted on Figures 4.7-5 through 4.7-8 included in Section 4.7.2.2.

Table 4.7-5. Measured Existing Sound Levels Representing Residential Receivers (dBA)

Measurement Location	SLM Date	Range of Measured Hourly Leqs		Range of Measured Hourly Lmax		Calculated Ldn
		Daytime	Nighttime	Daytime	Nighttime	
SLM1: 8351 15th Avenue NW	3/31/03	67-72	59-71	79-99	76-92	73.2
SLM2: 7325 15th Avenue NW	2/11/02	64-70	57-67	77-91	74-91	70.2
SLM3: 6712 16th Avenue NW	3/31/03	55-60	45-58	68-79	65-72	60.3
SLM4: 3821 14th Avenue W	4/7/03	61-65	56-64	68-80	66-84	66.9
SLM5: 505 W Mercer Place	3/26/03	65-70	61-68	72-86	69-84	71.4
SLM6: Second Ave & W Harrison St	2/8/02	55-60	48-56	72-82	64-75	60.5
SLM7: Near 2218 Fifth Avenue	3/31/03	67-78	58-76	82-104	77-103	76.5
SLM8: 2334 Second Avenue	2/9/02	57-64	54-62	71-92	68-86	65.8
SLM9: Pigeon Point	5/19/03	70-74	62-73	81-95	79-94	75.6
SLM10: 2803 SW Yancy Street	3/26/03	59-64	48-58	77-88	65-77	62.6
SLM11: 3249 SW Avalon Way	1/15/02	65-72	52-67	83-101	75-86	69.9
SLM12: 5948 California Avenue SW	3/26/03	62-66	50-62	74-81	70-82	65.5
SLM13: 6708 California Avenue SW	3/31/03	63-69	52-66	75-91	72-80	68.3
SLM14: 2518 SW Genesee St	12/3/03	61-68	52-62	79-101	75-90	65.8

Source: Sound level measurements by MFG, Inc. and SSA Acoustics.

As shown in Table 4.7-5, existing sound levels near almost all portions of the Green Line project area are fairly high. Existing levels at all locations were dominated by traffic noise from nearby roads.

Seattle Center Sound Level Measurements

In addition to the daylong sound level measurements at locations representing residential uses along the Green Line corridor, short-term sound level measurements were taken at outdoor locations at the Seattle Center. These measurements provide indications of existing levels at these outdoor use areas both with and without events at the Seattle Center. These measurements are summarized in Table 4.7-6.

Table 4.7-6. Measured Existing Sound Levels at Seattle Center at Various Times (dBA)

Location	Center Event	Date	Start Time	Duration	Leq	Lmax
Near Fisher Pavilion Roof	None	4/25/03	10:43 [a]	1 hour	57.5	93.1
Fisher Pavilion Roof	Folklife Festival	5/24/03	14.48 [b]	15 min	69.3	84.1
			17:40 [c]	15 min	68.7	94.1
Mural Amphitheater (near center of	None	4/25/03	9:38	1 hour	58.8	79.0
	Rhythm Festival	4/26/03	11:46 [d]	15 min	55.8	68.3
	Folklife Festival	5/24/03	14:22	15 min	81.0	96.6

Table 4.7-6. Measured Existing Sound Levels at Seattle Center at Various Times (dBA) (continued)

Location	Center Event	Date	Start Time	Duration	Leq	Lmax
audience space)	(during performances)		18:05	15 min	80.1	97.6
			18:20	15 min	82.6	96.5
Near Northwest Rooms	None	4/25/03	12:01	20 min	57.2	88.2
	Folklife Festival (during performances)	5/24/03	13:19	15 min	79.2	92.0
			13:35 [e]	15 min	70.0	80.8
			16:32	15 min	79.9	92.7
			16:48	15 min	76.1	90.3
Lawn Locations Near International Fountain	None	4/25/03	12:09 [f]	20 min	64.9	78.6
	Rhythm Festival	4/26/03	11:26 [d, g]	15 min	55.0	84.6
			18.34 [g]	15 min	72.9	102.5
	Folklife Festival	5/24/03	12:56 [g]	15 min	74.5	91.9
			16:10 [g]	15 min	77.8	90.1

[a] Roof area of Fisher Pavilion was not yet finished. SLM was taken near south edge of roof area.

[b] Near performance venue, but with no performance activity. No HVAC or other mechanical noise was noted during any sound level measurements at this location.

[c] With spoken performance at nearby venue.

[d] During World Rhythm Festival, but without any activity at this venue or nearby; used as background level.

[e] Between performances at nearby stage.

[f] On lawn east of fountain; included sound from fountain, people nearby, and some limited construction noise.

[g] On lawn north of fountain, with varying levels of activities nearby.

Source: Sound level measurements by MFG, Inc.

4.7.1.5 Vibration Standards and Criteria

The evaluation of vibration impacts uses standards and criteria developed by the Federal Transit Administration (FTA) for assessing vibration impacts related to transit projects. These standards are outlined in *Transit Noise and Vibration Impact Assessment* (FTA, Final Report, April 1995). The *Transit Noise and Vibration Impact Assessment* is the only standard for evaluating vibration impact from operation and construction of a wide range of mass transit projects. No local ordinance addresses structural vibration impact limits for mass transit systems.

The effects of ground-borne vibration from monorail trains to adjacent properties along the Green Line alignments are evaluated. This section focuses primarily on the impacts of operating Green Line trains; construction impacts are discussed in Section 4.17, Construction. The FTA guideline defines acceptable vibration levels depending on the land use category of the adjacent properties for frequent events and provides recommendations for vibration levels not to be exceeded during construction when historic buildings are in close proximity.

Design criteria have been established for High Sensitivity, Residential, Institutional Land Use, Special Buildings, and underground utilities, as well as for construction impacts. The basic concept of ground-borne vibration is that the train tires rolling on the guideway beams create vibration energy that is transmitted through the support structure and into the foundation. The vibration of the foundation creates vibration waves that propagate through adjacent soil and rock strata to the foundation of nearby buildings. The vibration propagates from the foundation throughout the remainder of adjacent building structures.

The vibration criteria for frequent events (more than 70 per day) for different land use categories defined by FTA Guidelines include:

- **Vibration Category 1: High Sensitivity** – Includes buildings where low ambient vibration is essential for the operations within the building. Typical land uses include sensitive research and manufacturing businesses, hospitals with vibration-sensitive equipment, and university research operations. The ground-borne vibration impact limit is 65 VdB re 1 micro inch/sec.
- **Vibration Category 2: Residential** – Includes all residential land uses and any building where people sleep, such as hotels and hospitals. The ground-borne vibration impact limit is 72 VdB re 1 micro inch/sec.
- **Vibration Category 3: Institutional** – Includes schools, churches, other institutions, and quiet offices that do not have vibration-sensitive equipment, but still have the potential for activity interference. The ground-borne vibration impact limit is 75 VdB re 1 micro inch/sec.
- **Vibration Criteria for Special Buildings** – Includes concert halls, TV and recording studios, auditoriums, and theaters.

Concert Halls	Ground-borne vibration impact limit is 65 VdB re 1 micro inch/sec.
TV Studios	Ground-borne vibration impact limit is 65 VdB re 1 micro inch/sec.
Recording Studios	Ground-borne vibration impact limit is 65 VdB re 1 micro inch/sec.
Auditoriums	Ground-borne vibration impact limit is 72 VdB re 1 micro inch/sec.
Theaters	Ground-borne vibration impact limit is 72 VdB re 1 micro inch/sec.

- **Construction Vibration Threshold Criteria** – Includes Historic Buildings

Fragile Buildings	Ground-borne vibration impact limit from construction activities is 100 VdB re 1 micro inch/sec.
Extremely Fragile Buildings	Ground-borne vibration impact limit from construction activities is 95 VdB re 1 micro inch/sec.

Extremely fragile buildings include historic brick buildings with a high risk of cracking. The construction vibration impact limits are approximate thresholds above which architectural damage could occur in some of the extremely fragile buildings.

4.7.1.6 Existing Vibration Measurements

The Green Line is an elevated street railway that would have rubber-tired vehicles traveling along elevated guideway beams supported by columns. Concrete pre-cast guideways would have a 5- to 7-foot depth and span between approximately 60 to 150 feet or greater for bridges or other special structures where needed. Expansion columns with expansion gaps between sections of guideway would be designed every third to sixth column to absorb dimensional changes, such as those caused by thermal expansion. Column foundations would be between 6 to 12 feet in diameter, with depths varying from 30 to greater than 100 feet depending on subsurface conditions. Green Line vehicles would travel at a maximum speed of 50 mph.

An elevated transportation system using pneumatic rubber tires and smooth concrete guideways, coupled with ground damping, would result in lower vibration levels when comparing elevated grade systems to at grade systems. The smoothness of the concrete guideway and the distance of the support structure to the closest receiver are the critical factors. The rubber tires plus the concrete columns together with ground damping (depending on soil type and conditions) and coupling losses between the ground and the foundation would provide a high degree of vibration damping.

This section analyzes structural vibration impacts from Green Line operation using the FTA standards for comparison purposes. Construction impacts are analyzed in Section 4.17, Construction. The study uses vibration data collected from the existing Seattle Center Monorail system as the vibration source levels with no reduction for new train or guideway design. Using the existing Seattle Center Monorail for vibration source data results in a conservatively high estimate of vibration impacts from the Green Line operations because existing monorail vehicles are over 40 years old, and newer vehicle technology would generate less vibration. In addition, modern construction techniques of the Green Line guideway would result in smoother and less frequent expansion gaps between sections of guideway compared to the existing monorail system, also resulting in lower vibration. The existing Seattle Center Monorail has expansion gaps at every column compared to every three to six columns for the proposed Green Line. Monorail vehicles traveling over these expansion gaps create the largest vibration levels based on the source data collected.

4.7.1.7 Vibration Measurement Setup and Descriptors

Existing vibration measurements of the existing Seattle Center Monorail system were taken to establish source levels for structural vibration. The measured vibration levels are a conservatively high estimate of the future vibration impact from the Green Line trains. Improvements to the train's suspension system and guideway construction will reduce the overall vibration levels for new monorail systems, due primarily to the smoothness of the guidebeam surface and the reduced number and size of the expansion gaps, which are the main sources of vibration. In addition, all measurements have been taken at a maximum speed of 50 mph for the impact analysis. In most locations, the Green Line trains would be traveling at lower speeds, thereby generating lower vibration levels than analyzed using the source data in this section.

All measurements are root mean square (RMS) velocity levels expressed in velocity dB, abbreviated VdB. Vibration velocity levels in decibels are defined as:

$$Lv = 20 \times \log 10 (V/Vref)$$

Lv - velocity level in VdB

V - RMS velocity amplitude

Vref - reference velocity amplitude

The reference vibration velocity used throughout this section is 1 micro inch per second (micro inch/sec).

Because the net average of a vibration signal is zero, RMS amplitude is used to describe the smoothed vibration amplitude. The RMS of a signal is the average of the squared amplitude of the signal. The average is typically calculated over the measurement period (duration of 30 seconds), similar to how the human body responds to an average vibration amplitude.

Although the vibration perceptibility threshold is about 65 VdB, human response to vibration is not usually significant unless the vibration exceeds 70 VdB (Figure 4.7-2).

65 VdB	Approximate threshold of perception for many humans.
75 VdB	Approximate dividing line between barely perceptible and distinctly perceptible. Many people find transit vibration at this level unacceptable.
85 VdB	Vibration acceptable only if there are an infrequent number of events per day.

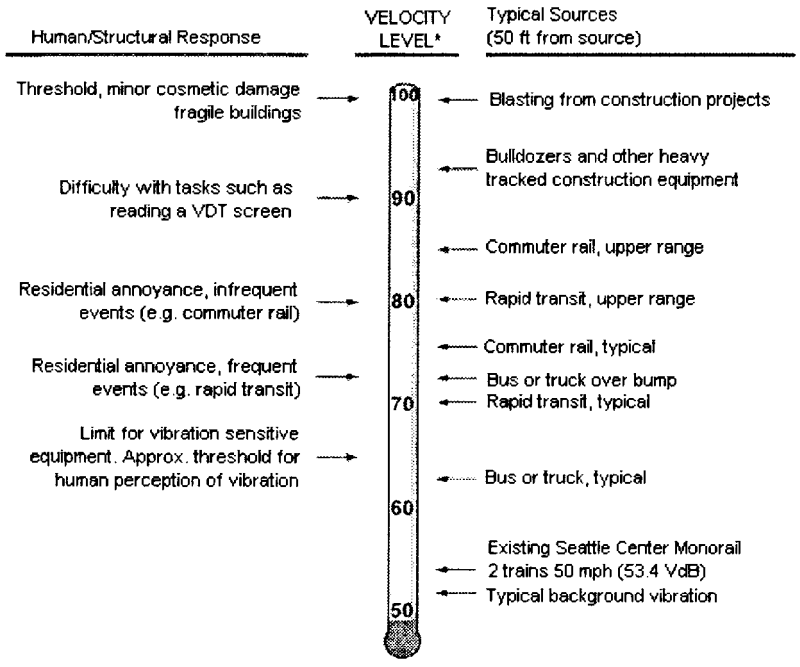
All transducers used for the vibration measurements were attached using magnetic bases coupled to a 2-by 2-inch steel plate and glued to the measured surface with industrial adhesive. The surfaces were clean and flat to provide optimal coupling between the transducers and test surfaces. Measurements were conducted with two transducers simultaneously.

Measurements along the existing monorail were taken on April 3, 2003. A summary of the results is presented in Table 4.7-7. A comprehensive set of vibration measurements for different system operating characteristics was taken as follows:

- At maximum vehicle speed (50 mph) at a guideway discontinuity (expansion gap).
- At a turn with the train going 30 mph.
- At a station with the train at maximum braking and acceleration.
- At different distances from the support column to assess how much source vibration is transmitted through support columns and into the adjacent ground.

The vibration velocity levels of typical sources would increase by 12 VdB re 1 micro inch/sec if the distance between source and receiver is reduced to 10 feet.

Figure 4.7-2. Typical Levels of Ground-Borne Vibration



* RMS Vibration Velocity Level in VdB relative to 1 micro inch/sec

Source: *Transit Noise and Vibration Impact Assessment* (FTA, Final Report, April 1995).

Measurements taken on top of the guideway support column with the train at maximum speed (50 mph) passing an expansion gap showed the highest vibration levels and have been used for the vibration impact predictions. The vibration damping levels measured at different distances away from a support column were found to be higher than published data. Therefore, these measurement results have not been used for the vibration impact assessment. Instead, the published "Generalized Ground Surface Vibration Curves" from the FTA Guidelines have been used to provide an estimate of vibration impacts.

Projected vibrations were developed based on measurements of existing monorail vehicles approaching and departing a station and were adjusted to reflect typical maximum speeds (50 mph) for the Green Line. Basing the analysis on train speeds of 50 mph is very conservative, as the average speed of the Green Line trains will be lower at most locations and therefore would also generate lower vibration impact than the model predictions.

Table 4.7-7. Existing Seattle Monorail Vibration Levels

Location	Vibration Level (VdB)	
	Ambient	with Train at 50 mph
Guideway/expansion gap	53.6	78.2
Column base	55.7	68.0
5 feet from base	53.3	62.9
10 feet from base	53.2	59.4
20 feet from base	51.8	53.3
30 feet from base	52.1	52.4
40 feet from base	50.7	50.9
50 feet from base	51.2	51.3
100 feet from base	49.8	49.8
Mid span between columns 38 and 39	58.7	72.3
Turn/expansion gap	54.1	74.4
Station EMP maximum braking	55.3	68.8
Station EMP maximum acceleration	55.3	68.9

Note: All measurements were taken for a duration of 30 seconds.

4.7.1.8 Methodology for Estimating Vibration from Green Line Operations

To estimate vibration levels from Green Line operations, a scenario reflecting the maximum possible vibration levels was developed. This scenario assumed two trains passing a column with expansion gaps simultaneously at a maximum speed of 50 mph. Existing vibration measurements have identified a train passing the expansion gaps as being the most severe vibration impact from Green Line operations. Predictions of ground-borne vibration levels at different distances from the centerline of the track are shown in Table 4.7-8.

Table 4.7-8. Predicted Source Vibration Levels

Description	Direction	Vibration Level
Two trains at 50 mph in opposite directions at guideway/expansion gaps	Vertical	84.2 VdB
Column base with two trains at 50 mph	Vertical	74.0 VdB
5 feet from face of base with two trains at 50 mph	Vertical	69.4 VdB
10 feet from face of base with two trains at 50 mph	Vertical	65.4 VdB
20 feet from face of base with two trains at 50 mph	Vertical	61.4 VdB
30 feet from face of base with two trains at 50 mph	Vertical	58.4 VdB
40 feet from face of base with two trains at 50 mph	Vertical	55.4 VdB
50 feet from face of base with two trains at 50 mph	Vertical	53.4 VdB
100 feet from face of base with two trains at 50 mph	Vertical	46.4VdB

RMS velocity levels, VdB re 1 micro inch/sec.

The predicted vibration levels in Table 4.7-8 are a conservatively high estimate of vibration levels from Green Line operations. The impact scenario evaluates the maximum theoretical vibration impact from two trains under the above conditions. In reality, it would be very unlikely for two Green Line trains to simultaneously pass a column with expansion gaps at the maximum 50 mph speed. This maximum speed can only be achieved on long, straight guideway sections with long enough spacing between stations to provide sufficient distance for accelerating and braking.

During the majority of time during Green Line operations, the structural vibration levels would be well below the stated maximums shown in Table 4.7-8. For example, one train going over an expansion gap would lower vibration levels by 6 VdB re 1 micro inch/sec compared to two trains passing at the same time. Worn out and brittle concrete has resulted in the removal of the steel flashing plates, which alters the expansion gap geometry on the existing Seattle Center Monorail. Newer train technology and construction design could reduce these factors, therefore reducing vibration levels.

Predictions for vibration damping with distance have been taken from the *FTA Transit Noise and Vibration Impact Assessment, Final Report* April 1995, Figure 10-1, "Generalized Ground Surface Vibration Curves" for Rubber-Tired Vehicles (30 mph). The curves in Figure 4.7-3 have been developed from numerous measurements of ground-borne vibration levels from rubber-tired vehicles at different distances, in different subsoil conditions. The curves represent the upper range of the measurement data, which means that although actual vibration levels show a 10 VdB re 1 micro inch/sec fluctuation depending on the subsurface conditions and coupling effects, it is rare that ground-borne vibration would exceed the vibration levels shown in these curves. Exceedances have only been documented in extenuating circumstances, such as rail corrugations or wheel flats not applicable for rubber-tired systems such as a monorail. As ground damping values do not change with the speed of a vehicle, the curve for rubber-tired vehicles at 30 mph can be applied to a system with 50 mph train speeds.

Damping versus distance values have been established for various setbacks from the Green Line using Figure 4.7-3. These values have been used to develop the predicted vibration impact levels at different distances from the alignment shown in Table 4.7-8. The source levels for Table 4.7-8 have been taken from the actual measurements at the column base of the existing monorail. Predicted future ground-borne vibration levels from the Green Line are shown in Figure 4.7-4. The predicted vibration levels stated in Figure 4.7-4 are conservatively high since the vibration levels assumed two trains passing over an expansion gap at the same time, at higher speeds than the Green Line would typically use, and used measurements from the 40-year-old existing Seattle Center Monorail. The actual vibration levels from the Green Line operation would be lower at almost all times and locations.

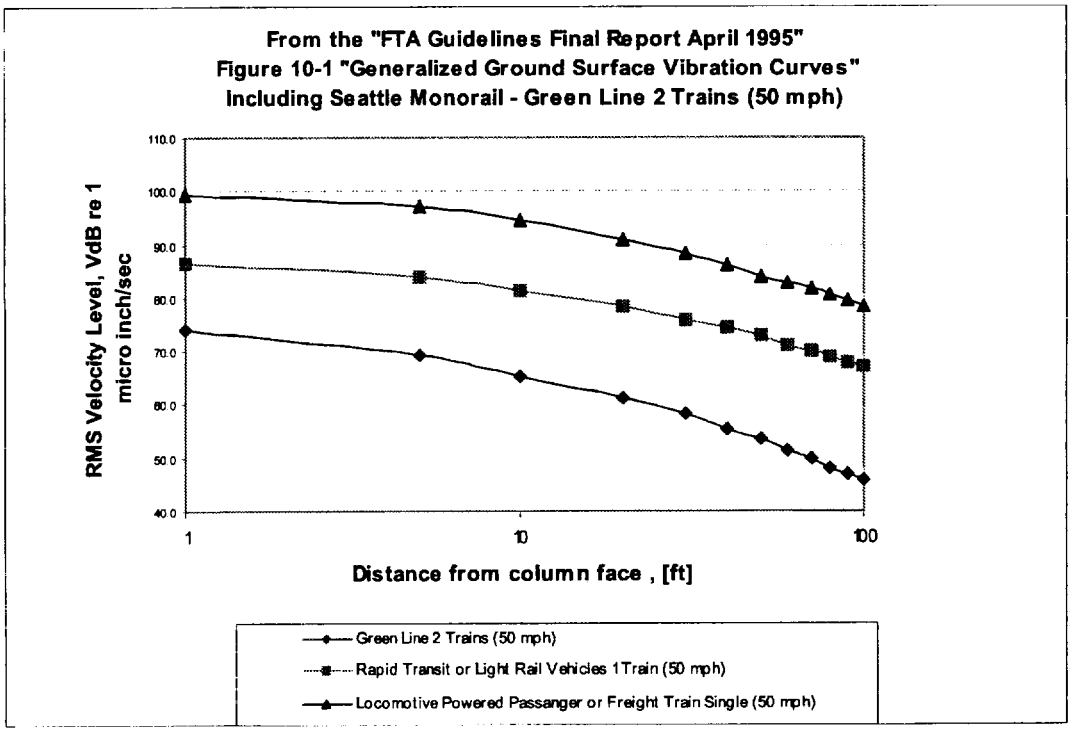
4.7.1.9 *Inventory of Vibration-Sensitive Sites*

The following buildings located in close proximity to one or more Green Line alternative alignments have been identified as land uses with a high sensitivity to structural vibration. The FTA vibration impact criteria have been used to identify sensitive receivers as specified in Vibration Category 1, High Sensitivity and Special Buildings.

Vibration Category 1: High Sensitivity – Included in Category 1 are buildings where low ambient vibration is essential for the operations within the building, which may be well below levels associated with human annoyance. Typical land uses covered by Category 1, High Sensitivity, are vibration-sensitive research and manufacturing, hospitals with vibration-sensitive equipment, and university research operations.

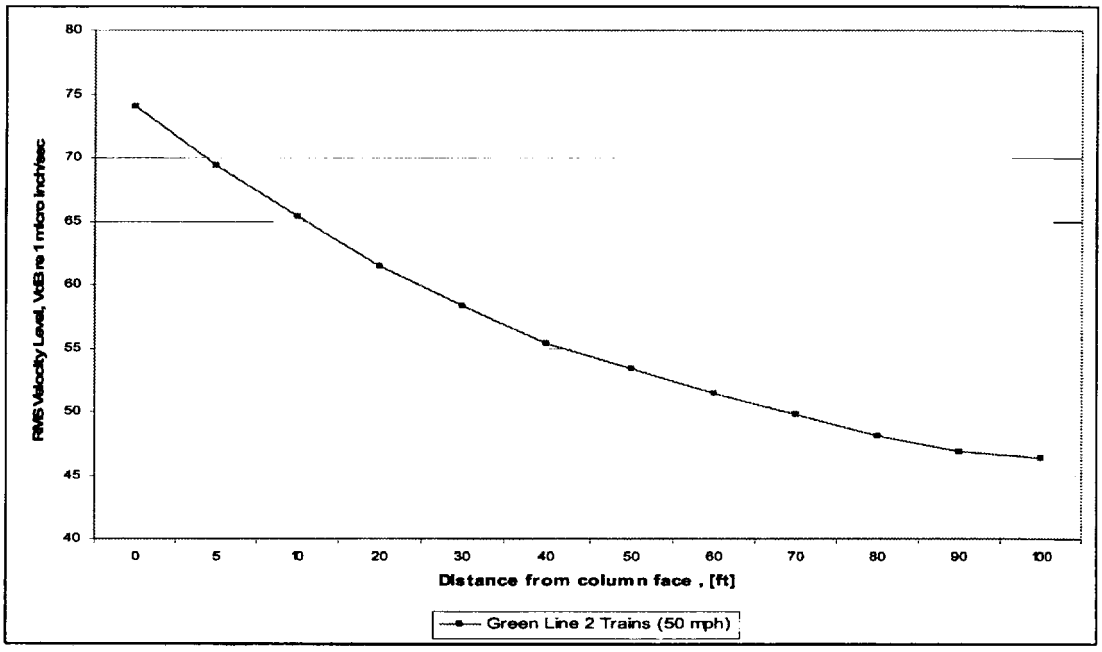
Vibration Criteria for Special Buildings – There are some buildings that do not fit into the High Sensitivity category, but because of the sensitivity of the buildings, they usually warrant special attention. Typical buildings covered by Category 2, Special Buildings, are concert halls, TV and recording studios, and theaters.

Figure 4.7-3. General Ground Surface Vibration Curves



Source: FTA "Transit Noise and Vibration Curves" for Rubber-Tired Vehicles.

Figure 4.7-4. Ground Surface Vibration Curve for the Green Line



There are four High Sensitivity buildings along the Green Line alternative alignments, three located in the Interbay/Magnolia Segment and one located in the Queen Anne/Seattle Center/Belltown Segment:

- Friedman & Bruya, Inc. Environmental Chemists at 3012 16th Avenue W. This building is located south of W Dravus Street and is approximately 20 and 100 feet away from Alternatives 2.1 and 2.2, respectively.
- Immunex/Amgen Campus at 1555 W Galer Street. This campus is located west of Elliott Avenue W south of the Magnolia Street Bridge and Galer Street overpass. The campus is approximately 250 to 200 feet away from Alternatives 2.1 and 2.2, respectively.
- Cell Therapeutics Inc. at 501 Elliott Avenue W. This business is located on the west side of Elliott Avenue W and is approximately 40 and 20 feet away from Alternatives 2.1 and 2.2, respectively.
- Pacific Biometrics Inc. at 220 W Harrison Street. This business is located on the north side of W Harrison Street, and is approximately 40 and 10 feet away from Alternatives 3.1 and 3.2 respectively.

Other facilities defined as Special Buildings located in close proximity to the Green Line alternative alignments include:

- Marion Oliver McCaw Hall at Seattle Center
- Seattle Repertory Theater at Seattle Center
- Intiman Playhouse at Seattle Center
- Seattle Children's Theater at Seattle Center
- Experience Music Project (EMP) at Seattle Center

- Fisher Pavilion at Seattle Center
- Moore Theater in Downtown Seattle
- Seattle Art Museum in Downtown Seattle
- Benaroya Hall in Downtown Seattle
- Arts West Theater in West Seattle

In addition to these High Sensitivity and Special Buildings, historic structures listed or eligible for listing in the National Register of Historic Places (NRHP) and City of Seattle landmark properties adjacent to the Green Line alternative alignments were also evaluated for construction vibration impacts.

Historic buildings can be categorized into Extremely Fragile Buildings and Fragile Buildings; however, not all historic buildings listed or eligible for listing in the NRHP are fragile. The FTA Guidelines Final Report from April 1995 does not provide specific guidance on how to define and categorize Fragile or Extremely Fragile Historic Buildings. From experience of similar projects and a seismic classification of different types of structures, the following categories have been assumed for this analysis:

- Extremely Fragile Buildings – Un-reinforced masonry, large un-reinforced concrete block, and old load-bearing timber structures with preexisting cracks in facade, with missing pieces of brick or plaster. Overall bad conditions, not well maintained property.
- Fragile Buildings – Un-reinforced masonry, large un-reinforced concrete block, load-bearing timber structures. No visible cracks in facade, well maintained, overall good condition.
- Not Fragile Buildings – Pre-cast concrete, well-maintained wood, or steel structures.

All historic properties have been evaluated and categorized using drawings where available and visual inspection. A list of historic buildings including classification is included in Table 4.17-6, Historic Resources and Construction Vibration Impact from Pile Driving.

4.7.2 Impacts

4.7.2.1 Operational Noise Impacts Related to Green Line Stations

Noise sources at Green Line stations would include the operation of trains, onboard equipment, and people entering and leaving the trains. As Green Line trains enter and leave stations, they must brake and then accelerate. With properly functioning trains, the process of starting and stopping does not generate much if any excess noise because the trains are powered by electric motors, and there is no engine noise as there is with equipment powered by internal combustion. In addition, stopping and starting are very short-term events.

When Green Line trains are not moving, there would be no noise related to tire movement, which is the primary noise source at speed. So while stopped at stations, the only noise from a train would be generated by onboard compressors that provide air to pressurize the hydraulic systems (e.g., for opening and closing the doors) and by the heating, ventilation, and possible air-conditioning (HVAC) systems. Each car would be equipped with compressors, but may or may not have HVAC systems. While the compressors and HVAC systems generate fairly low levels of noise that would probably be unnoticed by most users passing through the stations, this equipment generates sufficient noise to be potentially problematic at residential uses very near the stations. Based on the source noise measurements of the Disney World monorail described previously, the estimated noise from a stopped Green Line train is 51

dBA Ldn at a distance of 50 feet. Using this estimate, it is possible to calculate the approximate levels of noise from a stopped train at more distant locations like the off-site residences as described below.

Potential noise impacts from trains stopped at stations were assessed by screening the alternative station locations to identify the presence of nearby sensitive receivers (residences). For purposes of this screening, a distance of about 160 feet from the center of the station was used. (Refer to Appendix R, Noise and Vibration Backup Information in the Draft EIS, for more information.) After screening eliminated station locations with no nearby potentially affected receivers, a more detailed station noise analysis was used to identify potentially affected receiving locations. For this secondary analysis, the running Green Line train sound levels predicted with the Traffic Noise Model were added to the estimated idling noise from each station to determine the overall Green Line train-related sound levels at nearby sensitive receivers. This overall monorail noise was then compared to the FTA impact criteria based on the representative existing Ldn at each location. This analysis determined that the estimated Green Line train sound levels at residential locations near the vast majority of stations would either not be affected by idling noise, or would not experience a noise impact from the combined running and stopped noise. Only two potential station locations were identified as having residential locations nearby that could be affected by the inclusion of stopped Green Line train noise. These two stations are shown in Table 4.7-9. The station modifications and new stations added since the Draft EIS, including those associated with the Preferred Alternative did not change this conclusion.

Table 4.7-9. Estimated Noise Levels Near Two Alternative Monorail Stations (dBA)

Station	Existing Ldn	Station Idling Noise	Running Noise (from TNM)	All Green Line Train Noise (Idling + Running)	FTA Impact Level
Fifth and Stewart 3 (Lenora)	74	60	65	66	66
Pike 1	66	56	60	62	62

Source: MFG, Inc.

The overall noise level at the residential receivers closest to both these locations just exceeds the FTA impact level. Note that the estimates of idling noise are conservative, and the actual overall Green Line sound level may be lower than shown for the following reasons.

- The moving train noise estimated by the Traffic Noise Model (TNM) did not include the trains slowing to a complete stop at the stations. Therefore, the predicted running noise sound levels very near the stations are somewhat overestimated.
- The Green Line stations may themselves include some amount of structure that could obstruct noise transmitted from the stopped trains to the potentially affected residences. Because detailed design information for the stations was not available at the time of this analysis, it was not possible to conclusively determine any potential barrier reductions.
- The train that provided the basis of the equipment noise levels while stopped did not represent the same level of technology in either the noisy equipment (e.g., compressors and pumps) or the sound control applications that are available today.
- Idling noise measured from existing systems includes some elements (such as air conditioning) that may not be included on the Green Line.

Station Bus Layover Areas

All stations also would be serviced by nearby bus routes, and in some instances, bus routes and bus layover areas would be modified to improve service to Green Line passengers. (Bus layovers are already commonly used in many areas along the Green Line alternative alignments.) This would in some cases relocate bus traffic and bus stop zones near the stations and would create new bus stops and new bus layover areas. Such facilities could have noise impacts on nearby residential uses.

Based on review of all the potential bus layover areas, it was concluded that noise from buses at five of the possible layover areas associated with four stations has the potential to impact nearby residential receivers. These include the layover areas associated with the Dravus 1B, Delridge 1, Delridge 4, Avalon 2A, , and the Alaska Junction 2 stations. Potential noise impacts associated with these three possible facilities were assessed using the FTA transit noise assessment spreadsheet and representing the layover areas as "transit centers." It was assumed this calculation treated the bus sources as pass-through traffic that included some amount of idling. This would be a reasonable representation of the layover area operation unless such layovers do not occur during all hours of the day. The results of this review are described below.

Dravus 1B (east of 16th Avenue W): This bus layover area would be along the east or west side of 16th Avenue W, within about 100 feet of several existing homes. At this distance, and assuming the existing noise environment at this location that is fairly well shielded from direct exposure to traffic on 15th Avenue W, noise from bus layovers could cause potentially significant impacts at these homes. These potential noise impacts would require further monitoring and possible mitigation measures if bus layover activities occur at this location.

Delridge 1 (26th): This bus layover area would be approximately 60 feet from the nearest residences just south of the possible layover area. Up to seven buses could access this location at any one time. Assuming seven buses per hour would use the layover area each hour between 5:00 a.m. and midnight, the FTA spreadsheet predicts an L_{dn} of 62 dBA at the nearest residences. This could constitute a potentially significant noise impact according to FTA criteria, depending on the levels of existing noise at these residences. This potential noise impact will require further monitoring if bus layover activities occur at this location. Such impacts could very likely be controlled by site design and timing considerations (e.g., the actual layover area location, possible noise barrier, and whether buses idle for prolonged periods).

This bus layover area would be located outside the current street right-of-way, so noise from this facility could be subject to the City of Seattle noise limits. The site is zoned for industrial uses and the receiving residences are in a residential zone, so the day and night noise limits are 60 and 50 dBA, respectively. Given that the Green Line is expected to operate during nighttime hours (i.e., between 10:00 p.m. and midnight and between 5:00 and 7:00 a.m.), the more stringent noise limit would be the nighttime limit of 50 dBA. The calculated hourly L_{eq}, assuming seven buses use the layover area in any one-hour period, is 59 dBA. This predicted hourly sound level exceeds the 50-dBA nighttime limit, and noise mitigation would likely be necessary to meet the City noise limits if this site is chosen. The possible mitigation measures mentioned in the preceding paragraph also would be effective in allowing noise from this facility to meet the Seattle noise limits.

Delridge 4 (Genesee): This bus layover area would be located on the north side of SW Dakota Street just west of Delridge Way SW, approximately 40 feet from the nearest residence. Up to seven buses could access this location at any one time. Assuming seven buses per hour would use the layover area each hour between 5:00 a.m. and midnight, the FTA spreadsheet predicts an Ldn of 67 dBA at the nearest residence. This would likely constitute a potentially significant noise impact according to FTA criteria,

depending on the levels of existing noise at this residence. This potential noise impact would require further monitoring and possibly mitigation is bus layover activities occur at this location.

Avalon 2A (35th): This bus layover area would be sited on 35th Avenue SW, approximately 38 feet from an apartment building with 28 units. Up to four buses could use the site at any one time. Assuming that 4 buses per hour would use the layover area between 5 a.m. and midnight, the FTA spreadsheet calculated an Ldn of 65 dBA at the nearest residences. This could constitute a potentially significant impact using FTA criteria depending on existing sound levels at the units facing the layover area. This possible noise impacts would require further monitoring and possibly mitigation if these layover areas are chosen.

Alaska Junction 2 (44th/California): This bus layover area could be as close as 35 feet to the nearest residence. Up to five buses could use the site at any one time. Assuming three buses per hour would use the layover area between 5 a.m. and midnight, the FTA spreadsheet estimates an Ldn of 67 dBA at the nearest residences. This could constitute a potentially significant noise impact under FTA criteria, depending on the levels of existing noise at these residences. This potential noise impact would require further monitoring and possible mitigation measures if bus layover activities at this location.

Traction Power Substations

The Green Line would use traction power substations along the route to provide electrical power to the monorail. These units are small power substations, and thus involve transformers that emit noise. The power equipment at each substation would be completely enclosed in some form of building designed to minimize the transmission of transformer noise to the outdoor environment to the degree warranted by the local setting of each substation. For that reason, noise from these units would not be expected to cause noise impacts.

These traction power substations also could require the use of cooling or ventilation equipment that would generate noise. Noise from such equipment would be controlled to the extent necessary to comply with the applicable sound level limits in the Seattle noise rule.

Crossover Switches

The previously considered dual beam configuration alternatives would include several crossover switches to allow trains to move from one guideway to the other. The single beam portions of several alternatives and of the Preferred Alternative would include numerous switches to allow the trains to pass at stations and other locations. Switches are movable sections of the guideway up to about 100 feet long that would most likely be hydraulically operated devices, with the hydraulics pressurized by electric pumps. The pumps and the hydraulic equipment would create some noise. The guideway switches were not specifically considered in the noise analysis because based on practical observations by train experts Lea + Elliott (L+E), switches are believed to be a minor noise source compared with operational noise from the trains.

Because the switches are electrically powered and hydraulic, they are quieter than trains. Train engineering firms that work on these types of switches, as a matter of course, report that switches produce less noise than typical background levels in an urban setting. So in most locations, and at most times of day, switch noise would likely be masked by noise from existing sources. At quiet times, such noise could be noticeable, but it would likely still be a minor source compared with the noise from the moving trains. Consequently, switches would not be likely to be major contributors to the noise environment.

Switch sections of the guideway would likely include an additional under-guideway structure, probably made of concrete. This additional structure would create a partial barrier to noise created by the switches,

and also could provide the opportunity to add noise control for switching equipment, should this be determined to be necessary. Although impacts from switch noise are not anticipated, SMP's overall noise monitoring program would evaluate switch noise after the Green Line begins operations, and mitigation measures would be implemented if needed. Similar to train noise, the noise from switches would be monitored after Green Line construction, and noise shielding could be added to the switches if desirable. Unlike trains, switches are stationary and readily lend themselves to a noise shielding mitigation solution.

4.7.2.2 Operational Noise Impacts From Green Line Alternatives

The noise impact analysis completed for this Final EIS included additional modeling to supplement the modeling reported in the Draft EIS. The purpose of this modeling was to more closely examine the potential impacts associated with the Preferred Alternative that was designated after receiving comments on the Draft EIS. This latest effort also updated some of the modeling conducted for the Draft EIS using the latest available design information.

The impact analysis results reported below thus include the "old" and the "new" noise modeling. In most cases, the modeling for the Preferred Alternative is reported in the same tables as the results of the previous modeling. In these cases, the Preferred Alternative is highlighted in the tables. But the reader is advised that modeling for the Preferred Alternative is not necessarily directly comparable to the results of the previous modeling for the reasons explained in the methods portion of this section. The latest modeling for the Preferred Alternative uses refined assumptions about travel speeds and monorail headways that were not employed in the previous modeling.

Segment 1: Ballard Segment

The Ballard Segment of the Green Line was considered as four subsections based on the varying average speeds across the segment. The modeling results for the Ballard Segment are summarized in Table 4.7-10A and discussed following the table. The modeling receptors considered in this table are displayed in Figure 4.7-5. The potential for impacts is indicated in the columns labeled "Modeled Impact" in which the calculated monorail noise is compared with FTA noise impact criteria. Cells marked as either *Moderate* or *Potentially significant* denote locations that could be affected by noise from the Green Line.

The modeling results for the evaluation of Ballard Segment of the Preferred Alternative are presented in Table 4.7-10B. The approximate numbers of residential units affected by project alternatives are summarized in Table 4.7-15 at the end of the impacts discussion in this section.

Table 4.7-10a. Noise Impact Analysis Results - Ballard Segment

Segment Subdivision	Receptor #	Existing Ldn	Alternative 1.1		Alternative 1.2	
			Monorail Leq/Ldn	Modeled Impact	Monorail Leq/Ldn	Modeled Impact
NW 85th Street to NW 80th Street 25 mph	1	73	54	No Impact	51	No Impact
	2	72	64	No Impact	55	No Impact
	3	60	54	No Impact	52	No Impact
	4	72	55	No Impact	55	No Impact
	5	55	51	No Impact	51	No Impact

Table 4.7-10a. Noise Impact Analysis Results - Ballard Segment (continued)

Segment Subdivision	Receptor #	Existing Ldn	Alternative 1.1		Alternative 1.2	
			Monorail Leq/Ldn	Modeled Impact	Monorail Leq/Ldn	Modeled Impact
NW 80th Street to NW 65th Street 50 mph	6	72	74	Potentially significant	65	No Impact
	7	70	66	Potentially significant	62	No Impact
	8a	60	60	Moderate	53	No Impact
	8b	72	65	No Impact		No Impact
	9	72	63	No Impact	65	No Impact
	10a	56	59	Moderate	60	Moderate
	10b	72	63	No Impact	58	No Impact
NW 65th Street to NW Market Street 45 mph	11	70	61[a]	No Impact	58	No Impact
	12	72	69	Potentially significant	62	No Impact
	13	70	61	No Impact	59	No Impact
	14	60	59	Moderate	57	No Impact
	15	67	57	No Impact	57	No Impact
	16	59	55	No Impact	55	No Impact
NW Market Street to Ship Canal 50 mph	17	70	64	No Impact	61	No Impact
	18	63	61	Potentially Significant	58	No Impact

[a] Existing sound level adjusted to reflect removal of building shielding some receivers in this area. Previously predicted impacts at locations represented by this receptor were in error.

Source: Modeling and calculations by MFG, Inc.

Table 4.7-10b. Noise Impact Analysis Results - Ballard Segment: Alternative 1.1(s)

Segment Subdivision	Receptor #	Existing Ldn	Alternative 1.1(s) - *Preferred*	
			Monorail Leq/Ldn	Modeled Impact
NW 85th Street to NW 80th Street 15 mph	1	73	48	No Impact
NW 80th Street to south of NW 77th Street 50 mph	2	72	70	Potentially significant
	3	60	60	Moderate
	4	72	61	No Impact
	5	55	55	No Impact
S. of NW 77th Street to NW 67th Street 40 mph	6	72	65	No Impact
	7	70	59	No Impact
	8a	60	54	No Impact
	9	72	57	No Impact
	10a	56	53	No Impact
	10b	72	57	No Impact
NW 67th Street to NW 63rd Street 15 mph	8b	72	53	No Impact
	11	70	50	No Impact
NW 63rd Street to NW 52nd Street 15 – 40 mph	12	72	61	No Impact
	13	70	51	No Impact
	15	67	48	No Impact
	16	59	47	No Impact
	14	60	49	No Impact
	17	70	59	No Impact
NW 52nd Street to Ship Canal 50 mph	18	63	60	Potentially significant

Note: A new and more refined speed profile was used in the modeling of the Preferred Alternative. Receivers may therefore be in slightly different groupings than in the previous analysis represented in the previous table.

Source: Modeling and calculations by MFG, Inc.

Alternative 1.1 - West Side of 15th Avenue NW

NW 85th Street to NW 80th Street. Modeling indicates operation of the Green Line on the Alternative 1.1 alignment would not cause noise impacts within the northernmost subsection of the Ballard Segment between NW 85th and 80th Streets.

NW 80th Street to Ship Canal. Modeling indicates operation of the Green Line on the Alternative 1.1 alignment would cause noise impacts in the subsection of the Ballard Segment between NW 80th and the Ship Canal. FTA noise impact criteria suggest potentially significant noise impacts at all first row residential receivers west of the alignment in this section and moderate impact levels of noise at most second row residential receivers west of the road and at second row receivers east of and within 140 feet of the road.

Alternative 1.1(s) - West Side of 15th Avenue NW single beam – Preferred Alternative

NW 85th Street to North of NW 80th Street. Modeling indicates operation of the Green Line on the Alternative 1.1(s) alignment would not cause noise impacts within the northernmost subsection of the Ballard Segment between NW 85th Street and north of NW 80th Street.

North of NW 80th Street to South of NW 77th Street. Modeling indicates operation of the Green Line on the Alternative 1.1(s) alignment would cause noise impacts between just north of NW 80th Street and just south of NW 77th Street. Potentially significant noise impacts could occur at all first row receivers, and moderate impacts at all second row receivers west of the road.

NW 77th Street to NW 52nd Street. Modeling indicates the Alternative 1.1(s) alignment of the Green Line would not impact receivers between just south of NW 77th Street and NW 52nd Street.

NW 52nd Street to NW 51st Street. Modeling indicates the Alternative 1.1(s) alignment of the Green Line would cause potentially significant noise impacts between NW 52nd Street and NW 51st Street at first-row receivers west of the roadway.

Alternative 1.2 - Center of 15th Avenue NW

NW 85th Street to NW 80th Street. Modeling indicates operation of the Green Line on the Alternative 1.2 alignment would not cause noise impacts within the northernmost subsection of the Ballard Segment between NW 85th and 80th Streets.

NW 80th Street to NW 65th Street. TNM modeling indicates Alternative 1.2 of the Green Line would cause moderate noise impacts in the subsection of the Ballard Segment between NW 80th and NW 65th Streets. Modeling predicts moderate noise impacts at second row receivers east of and within 140 feet of the road.

NW 65th Street to Ship Canal. TNM modeling indicates Alternative 1.2 of the Green Line would not impact residential receivers in the subsection of the Ballard Segment between NW Market Street and the Ship Canal.

Ballard Segment: Preferred Alternative

In Ballard, Alternative1.1(s), a single beam configuration on the west side of 15th Avenue NW, has been designated as the Preferred Alternative. Noise impacts for the Preferred Alternative in Ballard are expected to be about the same or somewhat less than for Alternative 1.1 (which would feature a dual

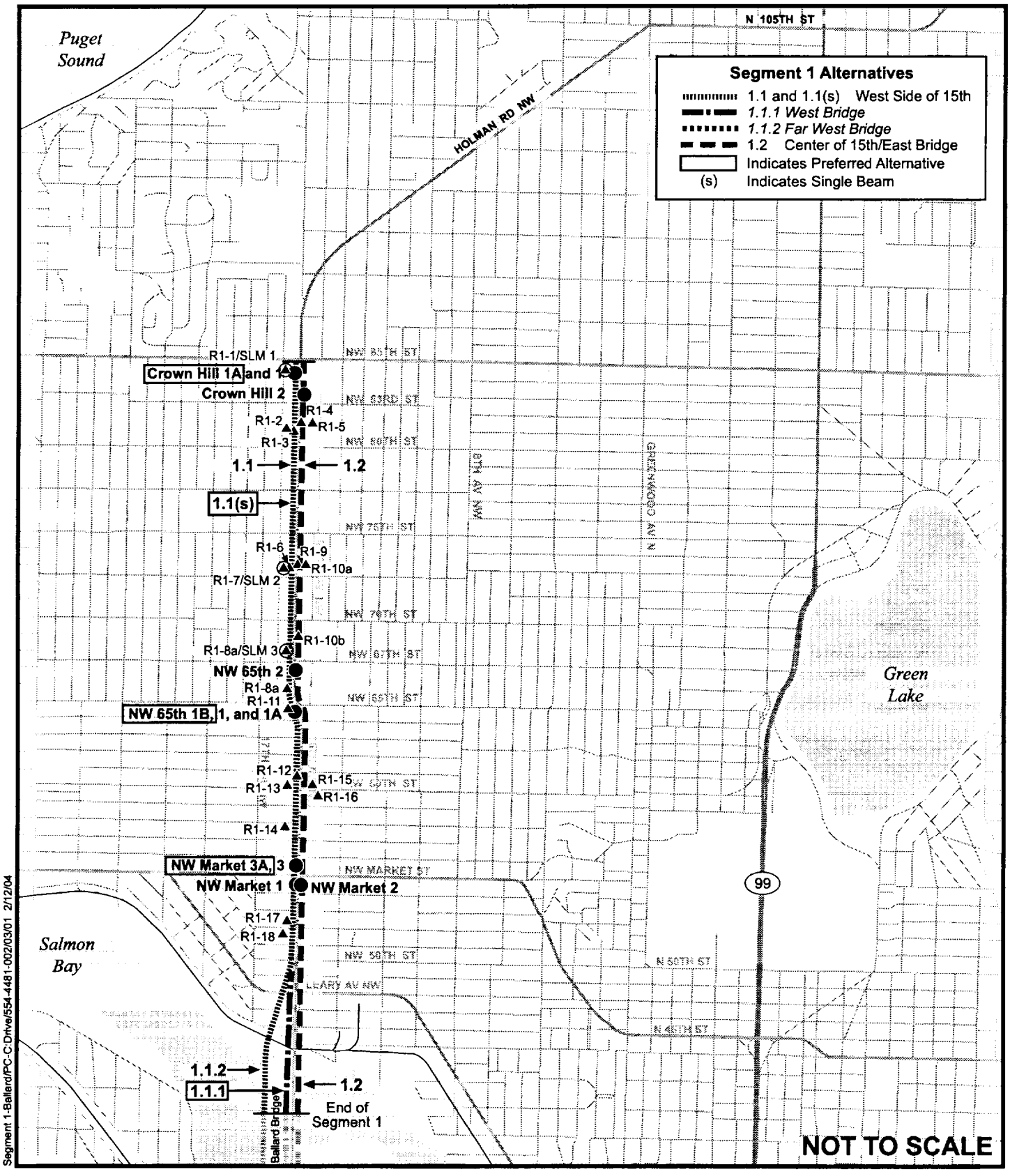


Figure 4.7-5
Segment 1: Ballard
SLM and Model Receptor Locations

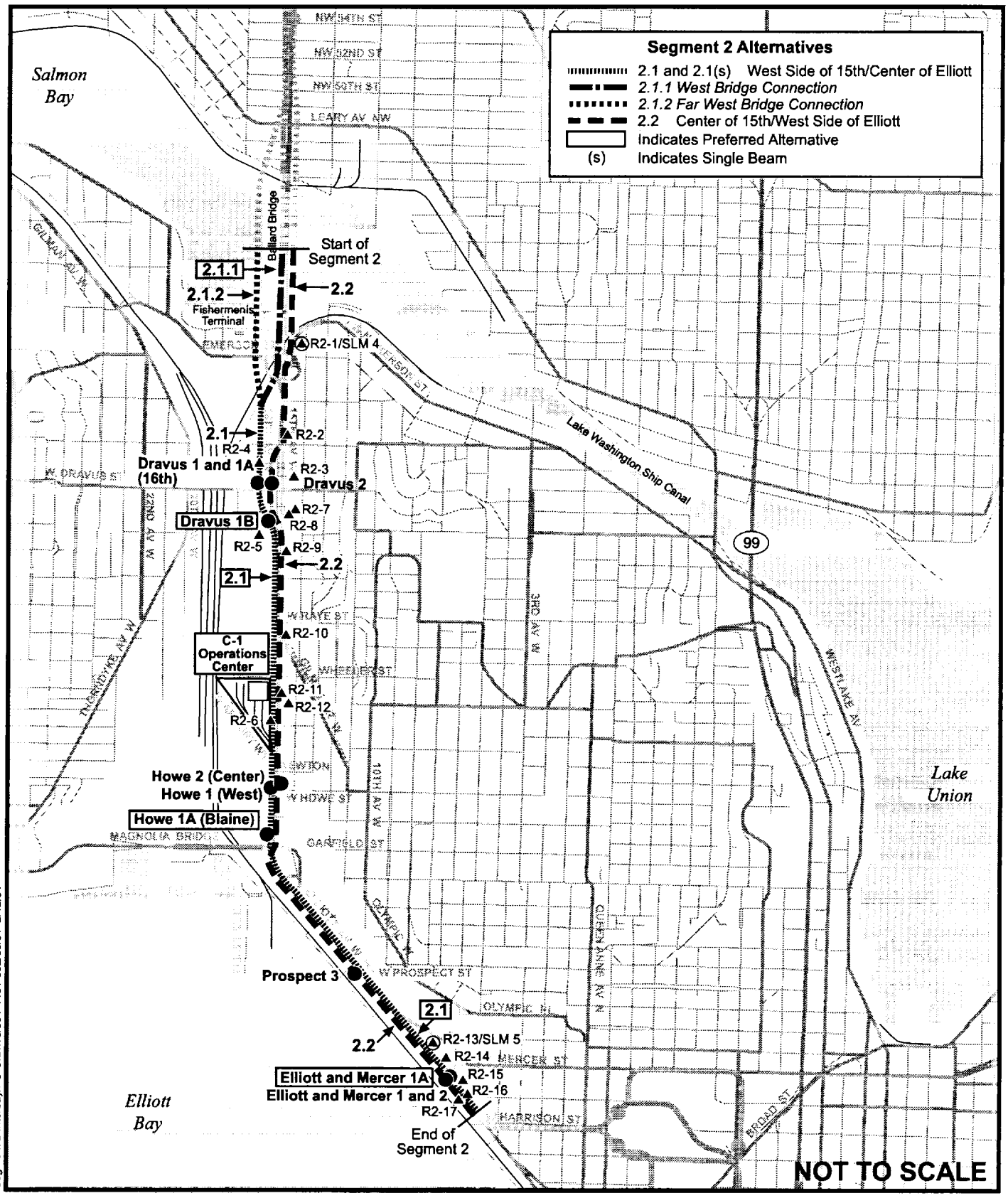
Table 4.7-11. Noise Impact Analysis Results - Interbay/Magnolia Segment

Segment Subdivision	Receptor #	Existing Ldn	Alternative 2.1 - *Preferred*		Alternative 2.2	
			Monorail Leq/Ldn	Modeled Impact	Monorail Leq/Ldn	Modeled Impact
Ship Canal to W Dravus Street 40 mph	1	70	50	No Impact	55	No Impact
	2	70	45	No Impact	57	No Impact
	3	63	42	No Impact	53	No Impact
	4	62 [(a)]	53 [(a)]	No Impact	53 [(a)]	No Impact
W Dravus Street to W Mercer Place 50 mph	5	62 [(a)]	52 [(a)]	No Impact	54 [(a)]	No Impact
	6	65 [(a)]	67 [(a)]	No Impact	63 [(a)]	No Impact
	7	63	46	No Impact	54	No Impact
	8	67	47	No Impact	55	No Impact
	9	74	57	No Impact	64	No Impact
	10	73	59	No Impact	61	No Impact
	11	74	62	No Impact	64	No Impact
	12	63	55	No Impact	57	No Impact
W Mercer Place to W Mercer Street 35 mph	13	71	51	No Impact	50	No Impact
	14	73	52	No Impact	53	No Impact
W Mercer Street to W Harrison Street 30 mph	15	71	49	No Impact	51	No Impact
	16	76	54	No Impact	53	No Impact
	17	70 [(a)]	52 [(a)]	No Impact	60 [(a)]	No Impact

[a] Level is highest 1-hour Leq instead of Ldn, as is appropriate for non-residential receivers. Source: Modeling and calculations by MFG, Inc.

NOTE: Single beam alternative, 2.1(s), was not evaluated with modeling. However, because of the similarities of the alignments, noise impacts would not be expected with Alternative 2.1(s) based on results of modeling Alternatives 2.1 and 2.2.

Source: Modeling and calculations by MFG, Inc.



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N

R2-1/SLM 4 Receptor and SLM

R2-2 Receptor

Figure 4.7-6
Segment 2: Interbay/Magnolia
SLM and Model Receptor Locations

beam configuration on the west side of 15th Avenue NW), but somewhat more than for Alternative 1.2 (which would travel above the center of 15th Avenue NW, and thus be farther from homes west of the road than the Preferred Alternative).

Segment 2: Interbay/Magnolia Segment

The Interbay Segment of the Green Line was considered as four subsections based on the varying average speeds along the alignment alternatives. The modeling results for the Interbay Segment are summarized in Table 4.7-11 and discussed following the table. The modeling receptors considered in Table 4.7-11 are displayed in Figure 4.7-6.

Alternative 2.1 – West Side of 15th/Center of Elliott – Preferred Alternative

Noise impact modeling indicates the Alternative 2.1 alignment of the Green Line through the Interbay Segment would not cause noise impacts at any of the residential, recreational, or commercial locations considered.

Alternative 2.1(s) – Single Beam, West Side of 15th/West Side of Elliott

The Alternative 2.1(s) alignment of the Green Line was not examined using noise modeling, however noise impacts are not expected from this alternative through the Interbay Segment, based on other modeling results that indicate no impacts for any of the proposed Interbay/Magnolia alignments.

Alternative 2.2 - Center of 15th/West Side of Elliott

Modeling indicates the Alternative 2.2 alignment of the Green Line through the Interbay Segment would not cause noise impacts in the Interbay Segment.

Interbay/Magnolia Segment: Preferred Alternative

In Interbay/Magnolia, Alternative 2.1 has been designated as the Preferred Alternative. Noise modeling indicates there would be no noise impacts in Interbay from operation of the Green Line along the Preferred Alternative route.

Interbay Operations Center Alternative

The Interbay Segment includes one of two possible locations for an Operations Center. The Interbay facility, recommended as part of the Preferred Alternative, would include maintenance, storage, operations control, and offices. The potential Operations Center location in this segment is on a triangular site between 15th Avenue W, W Wheeler Street, and W Armory Way. Green Line trains would access the site via guideways at W Armory Way, connecting to the mainline guideway along 15th Avenue W. For the connections to the mainline guideway, switches and crossover tracks would be required.

Noise from the Operations Center would be subject to the limits in the Seattle noise ordinance (see Table 4.7-4), and the residential limits would have to be met at the residential receivers east across 15th Avenue W of the potential Operations Center site. Noise control is one of many factors that would be considered in the ultimate design of this facility at this site. Noise occurring within this facility (e.g., light and heavy vehicle maintenance) would be substantially controlled by the structure of the building.

Much of the maintenance activity would likely involve relatively little noise. Louder activities would include such things as use of pneumatic tools and banging on metal that could result in temporary increases in noise in nearby, unshielded locations. Given the north/south alignment of the Green Line, the Operations Center would likely be oriented with its major openings facing north and/or south. There are

no residential receivers within 500 feet either directly north or south of this site. The closest residential uses are to the east, across 15th Avenue W, and these receivers are subject to high levels of traffic noise from this road.

The closest residence is approximately 250 feet east of the closest portion of the site where the Operations Center could be located. The estimated existing sound level at this residential location is 71 dBA Ldn. Under FTA criteria, it would take an Ldn level of 66 dBA from equipment noise to cause a noise impact. At a distance of 250 feet, pneumatic tools or banging on metal would produce noise levels less than 60 dBA, assuming there would not be direct line-of-sight exposure to the noise sources. Assuming such noise occurred all day and night, the resulting Ldn level at 250 feet (without direct line-of-sight) would be about 64 dBA. Because such maintenance activity would not occur consistently over a 24-hour period, the actual Ldn from such activity would likely be much lower, and thus would not cause an impact under FTA criteria.

The City of Seattle noise limits are based on the zoning of the noise source and the receiving properties. The proposed Interbay Operations Center site is on property zoned for industrial use, and the closest residences east of 15th Avenue W and adjacent to the roadway are in a commercial zone. The Seattle noise limit for industrial sources affecting commercial receivers is 65 dBA day and night, and the estimated sound levels at 250 feet (at locations without direct line-of-sight) of less than 60 dBA. Such levels would comply the City of Seattle noise limits.

Because maintenance operations noise could be effectively controlled, and given the distances to the closest sensitive receivers, noise from the proposed Interbay Operations Center would be expected to both comply with Seattle noise limits and to avoid noise impacts under FTA criteria.

Segment 3: Queen Anne/Seattle Center/Belltown Segment

The Queen Anne/Seattle Center/Belltown Segment of the Green Line was considered as four subsections that included the alternative alignments on all sides of the Seattle Center along with a number of receptor locations to consider Green Line noise on the Center grounds. The modeling receptors considered in this table are displayed in Figure 4.7-7. The results of the modeling for the Queen Anne/Seattle Center/Belltown Segment are displayed in Table 4.7-12. The approximate numbers of residential units affected by project alternatives are summarized in Table 4.7-15 at the end of the discussion of impacts in this section. Potential noise impacts at indoor and outdoor venues at the Seattle Center also were examined as part of this analysis as described later in this section.

Alternative 3.1 - Seattle Center/Republican – Preferred Alternative

W Harrison Street to First Avenue N. Modeling indicates all three Green Line alternative alignments traversing from Elliott Avenue W to First Avenue N could cause moderate to potentially significant noise impacts at first row residential locations along the north and south side of W Harrison Street. Second row residential buildings would not be impacted. In the Draft EIS, the Dalmasso Apartments building was assumed to be displaced by this alternative, and therefore would not experience any noise impacts. But, guideway profiles used in this Final EIS would have the Green Line fly over the building, thus resulting in potentially significant noise impacts, which could be potentially mitigated.

Seattle Center Area. The Alternative 3.1 alignment would not impact any other residential receivers in this segment. This alternative also would not impact outdoor use areas in the Seattle Center either during non-festival times or during large festivals. During quiet times in the Center, the Green Line would be clearly audible at outdoor locations near the Northwest Rooms and on the lawn north of the International Fountain, but Green Line noise would not substantially increase sound levels over the existing acoustic environment. Locations near the International Fountain are at times dominated by sounds from the

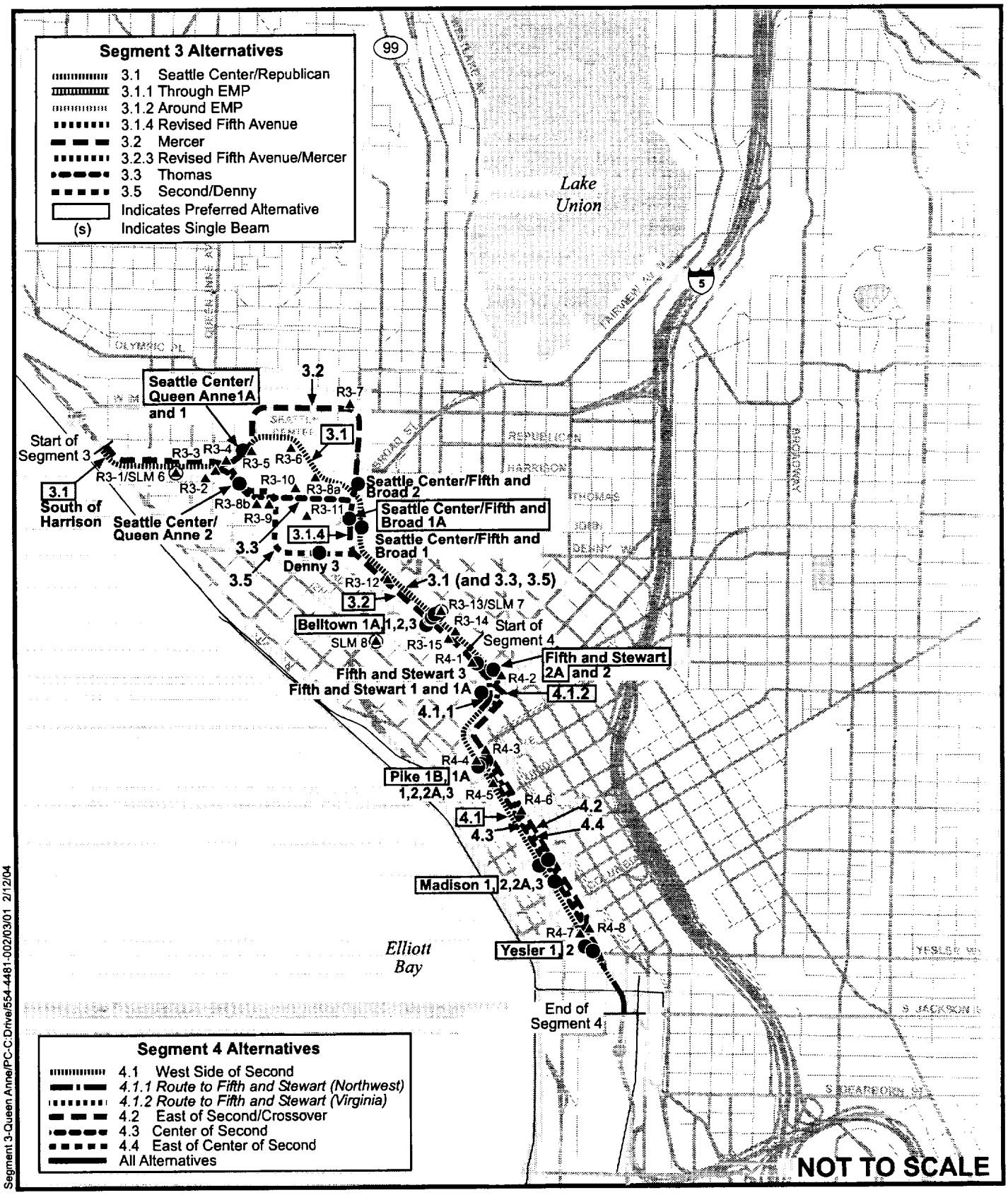

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Figure 4.7-7
Segments 3 and 4: Queen Anne/ Seattle Center/Belltown and Downtown/Pioneer Square SLM and Model Receptor Locations

Table 4.7-12. Noise Impact Analysis Results - Queen Anne/Seattle Center/Belltown Segment

Segment Subdivision	Rec #	SLM #/ Location	Existing Leq/Ldn	Alternative 3.1 – *Preferred*[a]		Alternative 3.2		Alternative 3.3		Alternative 3.5	
				MR Leq/ Ldn	Modeled Impact	MR Leq/ Ldn	Modeled Impact	MR Leq/ Ldn	Modeled Impact	MR Leq/ Ldn	Modeled Impact
W Harrison to Queen Anne Avenue N 30 - 40 mph	1	SLM 6	61	61	Moderate	63	Potentially significant	64	Potentially significant	62	Potentially significant
	2		61	52	No Impact	55	No Impact	57	No Impact	58	No Impact
	3		63	59	No Impact	62	Potentially Significant	66	Potentially significant	66	Potentially significant
	4		63	63	Potentially Significant	65	Potentially Significant	61	Potentially significant	61	Potentially significant
Queen Anne Avenue N to Vine Street 25 - 30 mph	5	Center Near Northwest Rooms	57[b]	51	No Impact	57[b]	Moderate				
			70[b]	51	No Impact	57[b]	No Impact				
			80[b]	51	No Impact	57[b]	No Impact				
	6	Center Fountain Lawn	55[b]	50	No Impact						
			73[b]	50	No Impact						
			78[b]	50	No Impact						
	7		70			63	No Impact				
	8a	Center House School	60[c]	50[b,d]	No Impact						
	8b	Off-site School	58[b]					57[b]	Moderate	52[b]	No Impact
	9	Church	58[b]					57[b]	Moderate	57[b]	Moderate
	10	Center Fisher	58[b]					54[b]	No Impact	48[b]	No Impact
			69[b]					54[b]	No Impact	48[b]	No Impact
	11	Center Mural	56[b]					51[b]	No Impact		
			80[b]					51[b]	No Impact		
Vine Street to Wall Street 15 - 40 mph	12		73	62	No Impact	63	No Impact	65	No Impact	59	No Impact
	13	SLM 7	73	52	No Impact	60	No Impact	60	No Impact	60	No Impact
	14		73	58	No Impact	60	No Impact	59	No Impact	59	No Impact
	15		73	61	No Impact	63	No Impact	65	No Impact	59	No Impact

[a] Alternative 3.1 is highlighted as the Preferred Alternative. The Preferred Alternative actually includes portions of Alternatives 3.1.1, 3.1.4, and 3.2.1, not listed in the table. The number of noise impacts that would result from these alternatives would be the same as Alternative 3.1.

[b] Level is highest 1-hour Leq instead of Ldn, as is appropriate for non-residential receivers. Cells that are grayed out indicate receptor locations that are too far from the respective alternative alignments to be affected by that alignment, so no tabulation is included.

[c] This estimate of existing levels is from an SLM in a more shielded location that is not subject to the same levels of noise from the existing amusement park (including a roller coaster) that dominates the exterior acoustic environment at the windows on the third and fourth floors of these school rooms

[d] Also represents Alternative 3.1.2.

Source: Modeling and calculations by MFG, Inc.

fountain, including splashing water, recorded music, and at times, screaming children. Close to the fountain, these noises would continue to dominate the acoustic environment. During performances at typical outdoor venues, and especially at locations near the stage (i.e., where people typically sit), sound levels from stage acts are usually much louder than the levels that would be expected from the Green Line. It is therefore unlikely that Green Line noise would interfere with most performances in outdoor venues at the Seattle Center.

Noise modeling also was used to examine the noise implications of the Alternative 3.1 and 3.1.2 alignments on sound levels outside the Center School classrooms on the third and fourth floors of the Seattle Center House. Judging from a visit to this facility, existing sound levels in these classrooms are dominated by HVAC noise when these rooms are otherwise quiet. The interior acoustic environment would be dominated by conversational sounds or music when these rooms are in use as classrooms. When the windows are closed, noise from outside is mostly inaudible except close to the windows; when the windows are open, noise from the roller coaster and other amusement park rides is at times clearly audible. The noise modeling analysis indicated the two alignment alternatives would have little or no effect on exterior sound levels near these classrooms. This means the Green Line also would have little or no effect on interior sound levels in these classrooms.

Seattle Center Interior Performance Venue Impact Assessment

Concern was raised by operators of both indoor and outdoor performance venues at the Seattle Center regarding the potential for noise from the Green Line to affect activities in these venues. The potential for noise impacts at these venues was assessed using sound level measurements of activities in several outdoor venues for comparison with predicted monorail noise at these same venues. Results of this analysis are discussed above in relation to various alternative alignments' potential to affect outdoor venues at the Center.

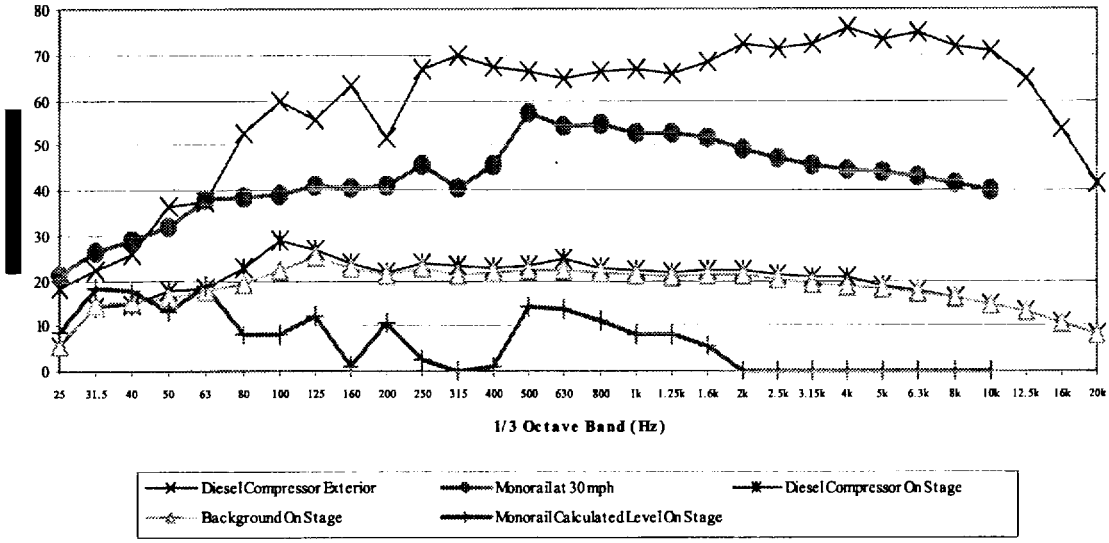
Additionally, the potential for effects at two indoor venues was assessed using data from several simultaneous interior/exterior measurements with a loud noise source running outside. These measurements were taken at interior spaces in both the Intiman and Leo K. Theaters and outdoors closer to the sound source, while the sound source (a large diesel compressor) was positioned at (or closer than) the approximate location of the Alternative 3.1 alignment near the theaters. The sound attenuation provided by the respective buildings was then assessed using measured sound levels inside and outside with and without the diesel compressor running. Comparing noise from the compressor with the noise from the Green Line, it was possible to evaluate the potential for monorail noise to affect interior performance spaces at the Center. Refer to Appendix R, Noise and Vibration Backup Information, for additional information regarding the details of this assessment.

Based on the measurements at the Intiman and Leo K. Theaters, it is clear that noise from the Green Line traveling at an average speed of 25 mph would not be likely to affect interior sound levels at any of the interior performance venues at the Center. As shown in Figure 4.7-8, noise from the Green Line would be less than measured background levels on the stage of the facility, and thus would most likely be inaudible. The lowest line in this chart represents the calculated level of monorail noise based on the expected outdoor level minus the noise reduction provided by the building envelope (based on these measurements). Because the monorail sound levels are less than the background levels measured in this theater when it was completely empty, noise from the monorail would be unlikely to be audible, especially when the theater is filled with people and the background level is much higher. In point of fact, noise from the diesel generator used in these tests was inaudible in the interior space even though the sound raised the background levels slightly during these measurements.

Denny Way to Lenora Street. The Green Line Alternative 3.1 alignment would not impact any residential receivers in these subsections of the Queen Anne/Seattle Center/Belltown Segment.

Other alternative alignments within this subsection, including Alternatives 3.1.1, 3.1.2, and 3.1.4, would not result in noise impacts at any residential, recreational, or commercial locations. Modeling results for these alternatives were not included in Table 4.7-12 to simplify the presentation of the analysis

Figure 4.7-8 Intiman Theater Stage Interior/Exterior Levels Using Diesel Compressor and Monorail Sound Level Measurements



Alternative 3.2 - Mercer

W Harrison Street to First Avenue N. Alternative 3.2 also could cause potentially significant impacts at first row residential locations along the north and south side of W Harrison Street. Second row residential buildings would not be impacted. The Dalmasso Apartments is the only residential building north of the road in this subsection.

Seattle Center Area. The Alternative 3.2 alignment could cause moderate noise impacts at outdoor use locations near the Northwest Rooms in the Center during low-use periods when background sound levels are low. During periods of more intense use, as during major festivals, sound levels from performance venues near the Northwest Rooms would be much louder than Green Line noise, so little if any impact would be expected. The Alternative 3.2 alignment would not affect existing residential uses along Mercer Street because Green Line noise would be far overshadowed by existing noise from the high traffic volumes along Mercer.

Denny Way to Lenora Street. The Green Line Alternative 3.2 alignment would not impact any residential receivers in this subsection of the Queen Anne/Seattle Center/Belltown Segment.

Other alternative alignments within this subsection, including Alternatives 3.2.1, 3.2.2, and 3.2.3, would not result in noise impacts at any residential, recreational, or commercial locations. Modeling results for these alternatives were not included in Table 4.7-12 to simplify the presentation of the analysis.

Alternative 3.3 - Thomas

W Harrison Street to First Avenue N. Alternative 3.3 could also cause potentially significant noise impacts at first row residential locations along the south side of W Harrison Street west of Queen Anne Avenue N and at first row receivers north of W Harrison Street and west of First Avenue N. The slight southward shift in this alignment could cause potentially significant noise impacts at the first row residential receivers south of W Harrison Street between Queen Anne Avenue N and First Avenue N. Second row residential buildings would not be affected.

Seattle Center Area. Modeling indicated the Alternative 3.3 alignment would not affect any outdoor use locations in the Seattle Center, but could cause moderate impacts at both the school and the church south of Thomas Street and east of Second Avenue N just outside the Center.

Denny Way to Lenora Street. The Alternative 3.3 alignment would not impact any residential receivers in this portion of the Queen Anne/Seattle Center/Belltown Segment.

Alternative 3.5 - Second/Denny

W Harrison Street to First Avenue N. The Alternative 3.5 alignment could cause potentially significant noise impacts at first row residential locations along the south side of W Harrison Street west of Queen Anne Avenue N, as well as first row receivers north of W Harrison Street and west of First Avenue N. The slight southward shift in this alignment would cause potentially significant noise impacts at the first row residential receivers south of W Harrison Street between Queen Anne Avenue N and First Avenue N. Second row residential buildings would not be affected.

Seattle Center Area. The Alternative 3.5 alignment would not cause impacts at any outdoor use locations in the Seattle Center, but could cause moderate impacts at the Sacred Heart Church south of Thomas Street and east of Second Avenue N just outside the Center.

Denny Way to Lenora Street. The Alternative 3.5 alignment would not cause impacts at any residential receivers in this portion of the Queen Anne/Seattle Center/Belltown Segment.

Queen Anne/Seattle Center/Belltown Segment: Preferred Alternative

In Queen Anne/Seattle Center/Belltown, portions of Alternatives 3.1, 3.1.1, 3.1.4, and 3.2.1 have been designated as the Preferred Alternative. The noise impact analysis indicates that the Preferred Alternative – as with all other alternatives studied – could cause impacts to first row residential locations on W. Harrison Street. Based on the refined alignment and speed profile used with the Preferred Alternative, it would have fewer impacts along the south side of W Harrison Street than the other alternative alignments because of the indicated slower travel speeds near one of the otherwise impacted residential receivers. All alternatives would cause potentially significant noise impacts at the Dalmasso Apartments; potential mitigation measures for this location would be evaluated in a subsequent review.

Within the Seattle Center, the Preferred Alternative would not impact outdoor use areas in the Seattle Center either during non-festival times or during large festivals, and would not be likely to impact interior performance spaces at the Center. The Alternative 3.2 alignment could cause moderate impacts at performance venues near the Northwest Rooms, and Alternatives 3.3 and 3.5 could cause moderate impacts at off-site receivers that would be close to these respective alignments. Finally, no noise impacts would be expected along Fifth Avenue through Belltown with any of the project alternatives.

Segment 4: Downtown/Pioneer Square Segment

The Downtown Segment of the Green Line was considered as four subsections. Results of the modeling are summarized in Table 4.7-13, and the modeling receptors considered in this table are displayed in Figure 4.7-7. The approximate numbers of residential units affected by project alternatives are summarized in Table 4.7-15 at the end of the discussion of impacts in this section.

Alternative 4.1 - West Side of Second

North of Virginia Street. Modeling indicates none of the Downtown Segment alternatives would impact residential receivers north of Virginia Street.

Virginia Street to Pike Street. Modeling indicates that Alternative 4.1 would not impact any receivers in this segment subsection.

Pike Street to Marion Street. Modeling indicates that Alternative 4.1 could cause potentially significant noise impacts at the residential receivers represented by receptor 5, which is the north end of the Newmark building west of Second Avenue between Pike Street and Union Street.

Marion Street to Yesler Way. Modeling indicates none of the Green Line alternative alignments would impact any receivers in this subsection of the Downtown Segment.

Options 4.1.1 and 4.1.2 to Alternative 4.1

Modeling suggests these alternative alignments would have the same noise effects as Alternative 4.1, and would only potentially significantly impact the residential receivers in the north end of the building west of Second Avenue between Pike Street and Union Street.

Table 4.7-13. Impact Analysis Results - Downtown Segment

			Alternative 4.1, 4.1.2 - *Preferred*		Alternative 4.2		Alternative 4.3	
Segment Subdivision	**Rec #**	**Existing Leq/Ldn**	**MR Leq/ Ldn**	**Modeled Impact**	**MR Leq/Ldn**	**Modeled Impact**	**MR Leq/Ldn**	**Modeled Impact**
North of Virginia Street 35 mph	1	74	60	No Impact	65	No Impact	61	No Impact
Virginia Street to Pike Street 25 mph	2	66	52	No Impact	55	No Impact	52	No Impact
	3	66	52	No Impact	63	Potentially significant	54	No Impact
	4	66	56	No Impact	54	No Impact	55	No Impact
Pike Street to Marion Street 40 mph	5	66	61	Potentially significant	54	No Impact	58	No Impact
	6	69 [a]	52 [a]	No Impact	66 [a]	Moderate	60 [a]	No Impact
Marion Street to Yesler Way 35 mph	7	69 [a]	57 [a]	No Impact	62 [a]	No Impact	60 [a]	No Impact
	8	69 [a]	51 [a]	No Impact	58 [a]	No Impact	59 [a]	No Impact

[a] Level is highest 1-hour Leq instead of Ldn, as is appropriate for non-residential receivers.

Source: Modeling and calculations by MFG, Inc.

Alternative 4.2 - East Side of Second with Crossover

Alternative 4.2 would shift noise impacts from the west to the east of Second Avenue and could potentially cause significant impacts at the residential building at the north end of the block between Pine and Pike Streets in the subsection between Virginia and Pike Streets. This alternative could also cause a moderate noise impact at the outdoor Garden of Remembrance at Benaroya Hall east of Second Avenue between Union Street and University Street.

Alternative 4.3 - Center of Second

Modeling suggests this alternative alignment would have less potential to cause noise impacts than Alternatives 4.1, 4.1.2, and 4.2, and would not cause impacts at any residential receivers.

Alternative 4.4 – East of Center on Second

Although Green Line Alternative 4.4 was not evaluated with noise modeling, this alternative closely matches the alignment of Alternative 4.2 (traversing the east side of Second and then crossing over to the west side of Second near Marion Street) that was considered with noise modeling. Along the east side of Second, Alternative 4.4 would be slightly closer to the centerline of the roadway, and farther away from receivers east of the road. Consequently, there would be no potentially significant impact at R4-3, as is predicted for Alternative 4.2. There would be a moderate noise impact at receptor R4-6. No other noise impacts are expected with Alternative 4.4.

Downtown Segment: Preferred Alternative

In the Downtown Segment, Alternative 4.1 with 4.1.2 option in the Fifth and Stewart area has been designated as the Preferred Alternative. This alignment would be expected to cause potentially significant noise impacts at some residences along Second Avenue that would not be expected with a center of street alignment (Alternative 4.3). This alignment would result in about the same impacts as the 4.2 east side alignment, just on the other side of the street. Note that the assessment for the Preferred Alternative conducted for the Final EIS included shorter headways in the downtown turn back area (i.e., more trains during peak periods) than the other alternatives, so direct comparisons are not appropriate.

Segment 5: SODO/Chinatown International District/Pioneer Square Segment

Due to the absence of sensitive noise receivers in the SODO Segment, no noise impacts would be expected. This segment was not examined using noise modeling. Likewise, the possible use of a site in this area for an Operations Center was not specifically considered in the noise analysis. But given the lack of sensitive receivers in the vicinity, it is unlikely this alternative for an Operations Center would result in noise impacts.

Segment 6: West Seattle Segment

The West Seattle Segment of the Green Line was considered as five subsegments, with additional subsections within each subsegment, as necessary. Results of the modeling are summarized in Tables 4.7-14A, 4.7-14B, 4.7-14C, 4.7-14D, and 4.7-14E, and the modeling receptors considered in these tables are displayed in Figure 4.7-9. The approximate numbers of residential units affected by project alternatives are summarized in Table 4.7-15 at the end of the discussion of impacts in this section. For each West Seattle subsegment, the noise modeling results are presented in separate tables, and discussed following the tables.

Table 4.7-14a. Impact Analysis Results - West Seattle Segment – Duwamish Subsegment

Segment Subdivision	Rec #	Existing Leq/Ldn	Alternative 6.1.1		Alternative 6.1.2		Alternative 6.2	
			MR Leq/Ldn	Modeled Impact	MR Leq/Ldn	Modeled Impact	MR Leq/Ldn	Modeled Impact
West Seattle Bridge to 22nd Avenue SW 40 mph	1	76	55	No Impact	62	No Impact	55	No Impact
	2	73	53	No Impact	58	No Impact	54	No Impact

NOTE: The Preferred Alternative is not highlighted in this table because it was not evaluated with modeling. An explanation of the Preferred Alternative in the Duwamish Subsegment, Alternative 6.1(s), is presented below.

Source: Modeling and calculations by MFG, Inc.

Alternative 6.1.1 - West Seattle Duwamish Subsegment - Past Pigeon Point

West Seattle Bridge to 22nd Avenue SW. Noise modeling indicates that the Alternative 6.1.1 of the Green Line alternative would not cause impacts at any receivers in this subsegment.

Alternative 6.1.2 - West Seattle Duwamish Subsegment - Near Pigeon Point

West Seattle Bridge to 22nd Avenue SW. Noise modeling indicates that the Alternative 6.1.2 of the Green Line alternative would not cause impacts at any receivers in this subsegment.

Alternative 6.1(s) - West Seattle Duwamish Subsegment - Past Pigeon Point – Single Beam – Preferred Alternative

West Seattle Bridge to 22nd Avenue SW. Noise modeling was not conducted for this alternative near Pigeon Point, so this alternative is not represented in Table 4.7-14A. However, based on modeling results of all other alternatives, noise impacts would not be expected at any receivers in this subsegment for Alternative 6.1(s), the Preferred Alternative of the Green Line alignment.

Alternative 6.2 - West Seattle Duwamish Subsegment New Monorail Bridge

West Seattle Bridge to 22nd Avenue SW. Noise modeling indicates that the Alternative 6.2 of the Green Line alternative would not cause impacts at any receivers in this subsegment.

Alternative 6.1 - West Seattle Delridge Subsegment – South of Longfellow Creek

Delridge Way SW to Avalon Way SW. Noise modeling indicates that potentially significant noise impacts could occur at first-row residential receivers along the south side of SW Yancy Street between 28th Avenue SW and 30th Avenue SW (Receptor 13). Modeling also indicates the potential for moderate impacts at a commercial location along Delridge Way SW (Receptor 3), and at a recreational facility (Longfellow Creek, represented by Receptor 4). No other noise impacts are expected.

Alternative 6.2 - West Seattle Delridge Subsegment – North of Longfellow Creek

Delridge Way SW to Avalon Way SW. Noise modeling indicates that Alternative 6.2 of the Green Line alternative alignment would not cause impacts at any receivers in this subsegment.

Alternative 6.3(s) - West Seattle Delridge Subsegment – Nucor Alternative – Preferred Alternative

Delridge Way SW to SW Yancy Street. Noise modeling was not conducted for this alternative alignment, so it is not included in Table 4.7-14B. However, because there are no sensitive receivers in the

Table 4.7-14b. Impact Analysis Results - West Seattle Segment – Delridge Subsegment

Segment Subdivision	Rec #	Existing Leq/Ldn	Alternative 6.1		Alternative 6.2		Alternative 6.4		Alternative 6.5	
			MR Leq/ Ldn	Modeled Impact	MR Leq/ Ldn	Modeled Impact	MR Leq/ Ldn	Modeled Impact	MR Leq/ Ldn	Modeled Impact
22nd Avenue SW to 30th Avenue SW 35 mph	3	79 [a]	66 [a]	Moderate	49 [a]	No Impact	48 [a]	No Impact	62 [a]	No Impact
	4	64 [a]	62 [a]	Moderate	53 [a]	No Impact	53 [a]	No Impact		
	5	72 [a]	53 [a]	No Impact	64 [a]	No Impact	57 [a]	No Impact		
	11	67	56	No Impact	50	No Impact	48	No Impact	53	No Impact
	12	70	59	No Impact	50	No Impact	49	No Impact	57	No Impact
	13	63	62	Potentially Significant	53	No Impact	59	No Impact		
	14	60	56	No Impact	50	No Impact	54	No Impact		
Genesee Alternative Delridge Way SW to SW Avalon Way	G1	64							62	Potentially Significant
	G2	64							58	No Impact
	G3	58							53	No Impact
	G4	58							54	No Impact
	G5	64							62	Potentially Significant
	G6	64							59	No Impact
	G7	66							61	No Impact
	G8	62							54	No Impact
	G9	66							57	No Impact
	G10	61							50	No Impact
	G11	66							61 [a]	No Impact
	G12	66							59	No Impact
	G15	66							51	No Impact
	G16	62							53	No Impact
	G13	66							54	No Impact
	G14	61							49	No Impact

[a] Level is highest 1-hour Leq instead of Ldn, as is appropriate for non-residential receivers. Cells that are grayed out indicate locations too far from the respective alternative alignments to be affected by that alignment, so no tabulation is included.

NOTE: The Preferred Alternative is *not* highlighted in this table because it was not evaluated with noise modeling. A discussion of the Preferred Alternative in the Delridge Subsegment, Alternative 6.3(s), is presented below.

Source: Modeling and calculations by MFG, Inc.

vicinity of this alternative, noise impacts would not be expected at any residential, recreational or commercial locations in this subsegment of Alternative 6.3(s), the Preferred Alternative of the Green Line alignment.

Alternative 6.4 - West Seattle Delridge Subsegment – Past Longfellow Creek

Delridge Way SW to Avalon Way SW. Noise modeling indicates that Alternative 6.4 of the Green Line alignment would not cause impacts at any receivers in this subsegment. The speed profile through this subsegment used to model Alternative 6.4 for the Final EIS was somewhat more refined than the speed profile used for the Alternative 6.1 modeling conducted for the Draft EIS because updated information was available for use in the later modeling. Although the alignments of Alternative 6.1 and 6.4 are very similar near R-13, the more refined speed profile modeling indicated impacts would not occur at this receiver. But even without a different speed profile, the 6.1 alignment would include a straight guideway section past receptor R-13, while the 6.4 alignment would include two nearby curves that would keep travel speeds somewhat lower than with the straight section. With the slower travel speed past this location, the potential for impacts would be reduced.

Alternative 6.4(s) - West Seattle Delridge Subsegment – Single Beam Past Longfellow Creek

Delridge Way SW to Avalon Way SW. Noise modeling was not conducted for this alternative in this subsegment, so it is not included in Table 4.7-14B. However, based on modeling results for Alternative 6.4, noise impacts would not be expected at any receivers in this subsegment of the Green Line alignment.

Alternative 6.5 - West Seattle Delridge Subsegment – Genesee Alternative

Delridge Way SW to Avalon Way SW. Noise modeling indicates that potentially significant noise impacts could occur at first-row residential receivers along the north side of SW Genesee Street, near SW Avalon Way, and along the south side of SW Genesee Street, near Delridge Way SW.

Alternative 6.1 - West Seattle Avalon Subsegment – Center of SW Avalon Way

30th Avenue SW to 36th Avenue SW. Noise modeling indicates that Alternative 6.1 of the Green Line alternative alignment would not cause impacts at any receivers in this subsegment.

Alternative 6.1.3 - West Seattle Avalon Subsegment – North Side of Fauntleroy Way SW

36th Avenue SW to 40th Avenue SW. Noise modeling indicates that potentially significant noise impacts could occur at first-row residential receivers along the north side of Fauntleroy Way SW, between 38th Avenue SW and 37th Avenue SW. No other noise impacts are expected along this subsegment of Alternative 6.1.3 of the Green Line alignment.

Alternative 6.1.4 - West Seattle Avalon Subsegment – South Side of Fauntleroy Way SW

36th Avenue SW to 40th Avenue SW. Noise modeling indicates that Alternative 6.1.4 of the Green Line alignment would not cause impacts at any receivers in this subsection of this subsegment.

Table 4.7-14c. Impact Analysis Results - West Seattle Segment – Avalon Subsegment

Segment Subdivision	Rec #	Existing Leq/Ldn	Alternative 6.1		Alternative 6.1.3		Alternative 6.1.4		Alternative 6.2		Alternative 6.2.1		Alternative 6.2.2 – *Preferred*	
			MR Leq/Ldn	Modeled Impact	MR Leq/Ldn	Modeled Impact	MR Leq/Ldn	Modeled Impact	MR Leq/Ldn	Modeled Impact	MR Leq/Ldn	Modeled Impact	MR Leq/Ldn	Modeled Impact
30th Avenue SW to 40th Avenue SW 35 mph	6	70	60	No Impact					60	No Impact				
	7	65	53	No Impact					53	No Impact				
	8	70			57	No Impact	54	No Impact						
	9	67			61	No Impact	57	No Impact						
	10	70			65	Potentially Significant	59	No Impact						
	15	70	59	No Impact					59	No Impact				
	16	67 [a]									64 [a]	No Impact	57 [a]	No Impact
	17	61									57	No Impact	59	Moderate
	18	67									58	No Impact	57	No Impact
	19	72 [a]			57 [a]	No Impact	64 [a]	No Impact						

[a] Level is highest 1-hour Leq instead of Ldn, as is appropriate for non-residential receivers. Cells that are grayed out indicate locations too far from the respective alternative alignments to be affected by that alignment, so no tabulation is included.

Source: Modeling and calculations by MFG, Inc.

Table 4.7-14d. Impact Analysis Results - West Seattle Segment – Alaska Subsegment

Segment Subdivision	Rec #	Existing Leq/Ldn	Alternative 6.1 - *Preferred* MR Leq/Ldn	Alternative 6.1 - *Preferred* Modeled Impact	Alternative 6.2 MR Leq/Ldn	Alternative 6.2 Modeled Impact
40th Avenue SW to SW Edmunds Street 40 mph	20	49			51	No Impact
	21	49			55	Moderate
	23	61	50	No Impact		

Cells that are grayed out indicate locations too far from the respective alternative alignments to be affected by that alignment, so no tabulation is included.

Source: Modeling and calculations by MFG, Inc.

Alternative 6.2 - West Seattle Avalon Subsegment – Center of SW Avalon Way

30th Avenue SW to 35th Avenue SW. Noise modeling indicates that Alternative 6.2 of the Green Line alignment would not cause impacts at any receivers in this subsegment.

Alternative 6.2.1 - West Seattle Avalon Subsegment – East Side of 35th Avenue SW

SW Avalon Way to 40th Avenue SW. Noise modeling indicates that Alternative 6.2.1 of the Green Line alignment would not cause impacts at any receivers in this subsegment.

Alternative 6.2.2 - West Seattle Avalon Subsegment – Center of 35th Avenue SW – Preferred Alternative

SW Avalon Way to 40th Avenue SW. Noise modeling indicates that moderate noise impacts could occur at first-row residential receivers along the west side of 35th Avenue SW, between SW Avalon Way and SW Alaska Street (an apartment building). No other noise impacts are expected along this subsegment of the Green Line alignment.

Alternative 6.1 - West Seattle Alaska Subsegment – 42nd Avenue SW – Preferred Alternative

40th Avenue SW to SW Edmunds Street. Noise modeling indicates that Alternative 6.1 of the Green Line alignment would not cause impacts at any receivers in this subsegment.

Alternative 6.2 - West Seattle Alaska Subsegment – 44th Avenue SW

40th Avenue SW to SW Edmunds Street. Noise modeling indicates that moderate noise impacts could occur at first-row residential receivers along the east side of 44th Avenue SW, just north of SW Alaska Street. No other noise impacts are expected along this subsegment of the Alternative 6.2 of the Green Line alignment.

Alternative 6.1 - West Seattle California Subsegment – Center of California Avenue SW

SW Edmunds Street to SW Hudson Street. Noise modeling indicates that Alternative 6.1 of the Green Line alignment would not cause impacts at any receivers in this subsegment.

SW Hudson Street to SW Dawson Street. Noise modeling indicates that potentially significant noise impacts could occur at first-row residential receivers along the east and west sides of California Avenue SW, within this subsegment. No other noise impacts are expected along this section of the California subsegment of Alternative 6.1 of the Green Line alignment.

Table 4.7-14e. Impact Analysis Results - West Seattle Segment – California Subsegment

Segment Subdivision	Rec #	Existing Leq/Ldn	Alternative 6.1		Alternative 6.1.6		Alternative 6.1.6(s)[a] *Preferred*		Alternative 6.2	
			MR Leq/ Ldn	Modeled Impact	MR Leq/ Ldn	Modeled Impact	MR Leq/ Ldn	Modeled Impact	MR Leq/ Ldn	Modeled Impact
SW Edmunds Street to SW Hudson Street 20 mph	22	66	56	No Impact	56	No Impact	54	No Impact	54	No Impact
	24	66	55	No Impact	52	No Impact	50	No Impact	59	No Impact
	25	61	50	No Impact	48	No Impact	44	No Impact	50	No Impact
SW Hudson Street to SW Dawson Street 35 mph	26	66	62	Potentially significant	63	Potentially significant	57	No Impact	60	No Impact
	27	66	62	Potentially significant	58	No Impact	54	No Impact	67	Potentially significant
	28	61	53	No Impact	52	No Impact	47	No Impact	54	No Impact
North of SW Dawson Street to SW Dawson Street 20 mph	28a	66					58	No Impact		
	28b	61					50	No Impact		
SW Dawson Street to SW Raymond Street 50 mph	29	66	68	Potentially significant	68	Potentially significant	67	Potentially significant	66	Potentially significant
	30	63	57	No Impact	56	No Impact	54	No Impact	59	No Impact
	31	66	62	Potentially significant	59	No Impact	58	No Impact	63	Potentially significant
	31a	61					54	No Impact		
	31b	66					63	Potentially Significant		
	31c	66					69	Potentially significant		
	31d	63					57	No Impact		
	32	61	57	No Impact	55	No Impact	52	No Impact	58	No Impact
	33	66	68	Potentially significant	64	Potentially significant	60	No Impact	73	Potentially significant
SW Raymond Street to SW Graham Street 40 mph	34	66	63	Potentially significant	63	Potentially significant	63	Potentially significant	65	Potentially significant
	35	66	64	Potentially significant	60	No Impact	58	No Impact	81	Potentially significant
SW Graham Street to south of SW Holly Street 25 mph	36	66	59	No Impact	59	No Impact	62	Potentially Significant	66	Potentially Significant
	37	68							58	No Impact
	38	66	58	No Impact	55	No Impact	51	No Impact	69	Potentially significant
	39	68	55	No Impact	52	No Impact	47	No Impact	62	No Impact
	40	68							57	No Impact

[a] Speed profile and headway information used for 6.1.6(s) were based on more detailed information than any other alternative presented in this table. Comparison of impacts among 6.1.6(s) and other alternatives is therefore not accurate.

Source: Modeling and calculations by MFG, Inc.

SW Dawson Street to SW Raymond Street. Noise modeling indicates that potentially significant noise impacts could occur at first-row residential receivers along the east and west sides of California Avenue SW, within this subsegment. Potentially significant noise impacts could also occur at receivers set back approximately 100 feet from California Avenue SW along the east side of the road within this subsegment. No other noise impacts are expected.

SW Raymond Street to SW Graham Street. Noise modeling indicates that potentially significant noise impacts could occur at first-row residential receivers along the east and west sides of California Avenue SW, within this subsegment. No other noise impacts are expected along this section of the California subsegment of Alternative 6.1 of the Green Line alignment.

SW Graham Street to south of SW Holly Street. Noise modeling indicates that Alternative 6.1 of the Green Line alignment would not cause impacts at any receivers in this subsegment.

Alternative 6.1.6 - West Seattle California Subsegment – West Side of California Avenue SW

SW Edmunds Street to SW Hudson Street. Noise modeling indicates that Alternative 6.1.6 of the Green Line alignment would not cause impacts at any receivers in this subsegment.

SW Hudson Street to SW Dawson Street. Noise modeling indicates that potentially significant noise impacts could occur at first-row residential receivers along the west side of California Avenue SW, within this subsegment. No other noise impacts are expected along this section of the California subsegment of Alternative 6.1.6 of the Green Line alignment.

SW Dawson Street to SW Raymond Street. Noise modeling indicates that potentially significant noise impacts could occur at first-row residential receivers along the east and west sides of California Avenue SW, within this subsegment. No other noise impacts are expected along this section of the California subsegment of Alternative 6.1.6 of the Green Line alignment.

SW Raymond Street to SW Graham Street. Noise modeling indicates that potentially significant noise impacts could occur at first-row residential receivers along the west side of California Avenue SW, within this section of the California subsegment. No other noise impacts are expected.

SW Graham Street to south of SW Holly Street. Noise modeling indicates that Alternative 6.1.6 of the Green Line alignment would not cause impacts at any receivers in this subsection of this segment.

Alternative 6.1.6(s) - West Seattle California Subsegment – Single Beam - West Side of California Avenue SW – Preferred Alternative

SW Edmunds Street to SW Dawson Street. Noise modeling indicates that Alternative 6.1.6(s) of the Green Line alternative alignment would not cause impacts at any receivers in this section of the California subsegment of the Green Line alignment.

SW Dawson Street to SW Raymond Street. Noise modeling indicates that potentially significant noise impacts could occur at first-row residential receivers along the east and west sides of California Avenue SW, within this section of the California subsegment of Alternative 6.1.6(s). No other noise impacts are expected.

SW Raymond Street to SW Holly Street. Noise modeling indicates that potentially significant noise impacts could occur at first-row residential receivers along the west side of California Avenue SW, within

this section of the California subsegment of Alternative 6.1.6(s) of the Green Line alignment. No other noise impacts are expected.

Alternative 6.2 - West Seattle California Subsegment – East Side of California Avenue SW

SW Edmunds Street to SW Hudson Street. Noise modeling indicates that Alternative 6.2 of the Green Line alignment would not cause impacts at any receivers in this section of the California subsegment.

SW Hudson Street to SW Dawson Street. Noise modeling indicates that potentially significant noise impacts could occur at first-row residential receivers along the east side of California Avenue SW, within this section of the California subsegment of Alternative 6.2. No other noise impacts are expected.

SW Dawson Street to SW Raymond Street. Noise modeling indicates that potentially significant noise impacts could occur at first-row residential receivers along the east and west sides of California Avenue SW, within this subsegment. Potentially significant noise impacts could also occur at receivers set back from California Avenue SW along the east side of the road, within this section of this subsegment. No other noise impacts are expected along this section of the California subsegment of Alternative 6.2 of the Green Line alignment.

SW Raymond Street to SW Graham Street. Noise modeling indicates that potentially significant noise impacts could occur at first-row residential receivers along the east and west sides of California Avenue SW, within this section of the California subsegment of Alternative 6.2. No other noise impacts are expected.

SW Graham Street to south of SW Holly Street. Noise modeling indicates that potentially significant noise impacts could occur at first-row residential receivers along the east side of California Avenue SW, within this section of the California subsegment of Alternative 6.2. No other noise impacts are expected.

Preferred Alternative - West Seattle – Combinations of Subsegments (summary)

Duwamish Subsegment: Alternative 6.1.1(s). Noise modeling was not conducted for this alternative past Pigeon Point. However, based on modeling results of all other alternatives, noise impacts are not expected at any receivers in this subsection of this segment. Similarly, noise impacts are not expected with any other Green Line Alternative in this subsegment.

Delridge Subsegment: Alternative 6.3(s). Noise modeling was not conducted for this alternative in this subsegment. However, because there are no sensitive receivers in the vicinity of this alternative, noise impacts are not expected at any residential, recreational, or commercial locations in this subsegment. The same is true for Alternatives 6.2, 6.4, and 6.4(s). In contrast, alternatives 6.1 and 6.5 (Genesee) through this subsegment would be expected to result in potentially significant noise impacts at residential receivers in this subsegment because both these alignments contain more straight guideway sections where the monorail trains would travel faster near homes in this area.

Avalon Subsegment: Alternative 6.2.2. Noise modeling indicates that moderate noise impacts could occur at the numerous first-row residential receivers along the west side of 35th Avenue SW, between SW Avalon Way and SW Alaska Street (an apartment building). Alternative 6.1.3 would also be expected to cause potentially significant noise impacts at some residential receivers in this subsegment, but at far fewer than the Preferred Alternative because the 6.1.3 alignment is on the north side of Fauntleroy where there are fewer nearby homes. No other Green Line Alternatives through this subsegment would be expected to cause noise impacts because the 6.1.4 alignment along the south side of Fauntleroy passes

near commercial uses, and the 6.2.1 alignment is along the east side of 35th, and is thus farther from residences in this area.

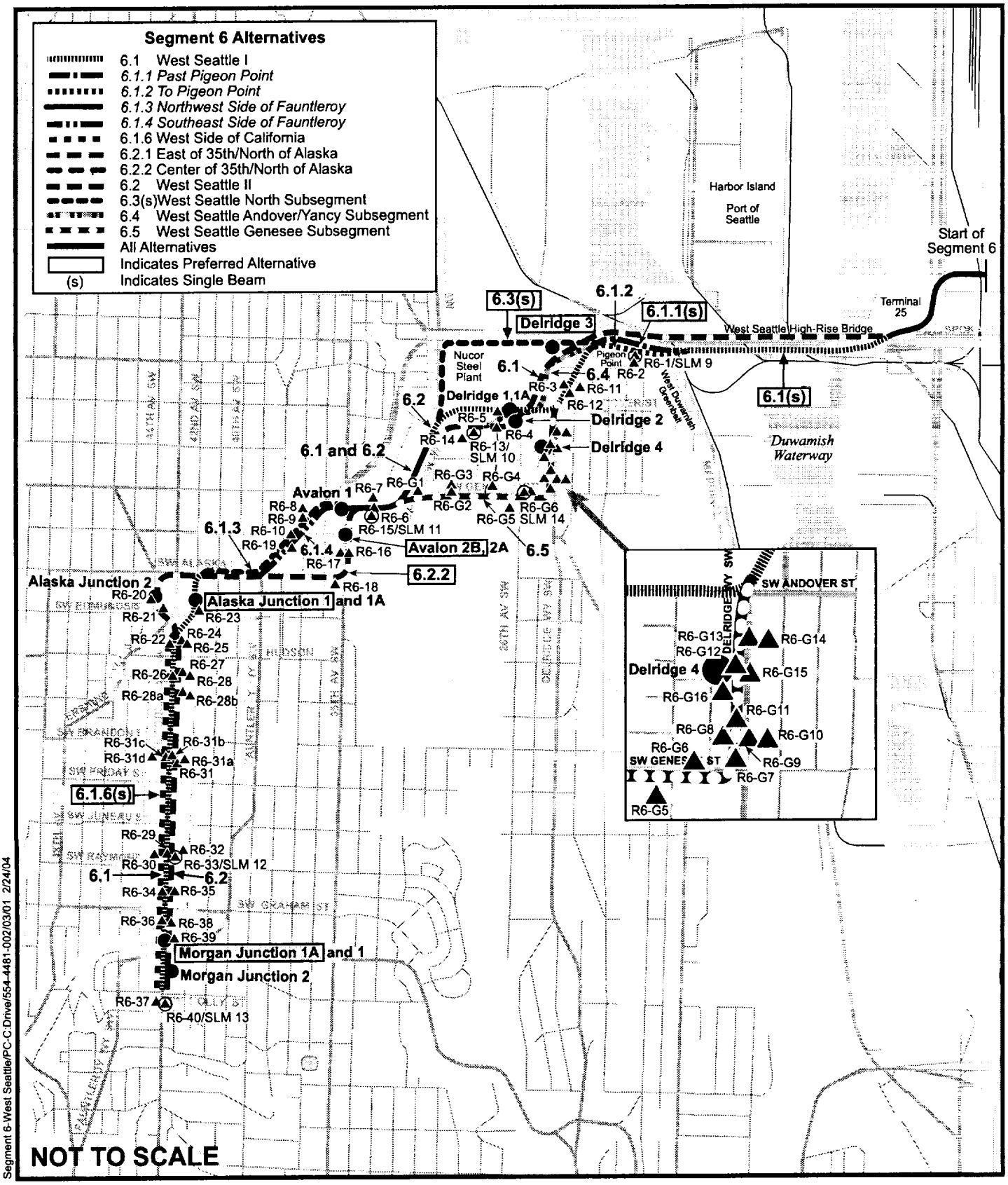
California Subsegment: Alternative 6.1.6(s):

SW Edmunds Street to SW Dawson Street. Noise modeling indicates that Alternative 6.1.6(s) of the Green Line alignment would not cause impacts at any receivers in this section of the California subsegment of the Green Line alternative alignment. Although a direct comparison of this alternative with other alternatives is not strictly possible due to refinements in modeling assumptions (i.e., speed and headway), a close comparison would likely find that no impacts would occur in this area with Alternative 6.1.6 using a more refined speed profile. This contrasts with the findings of the Draft EIS modeling assessment that indicated potentially significant impacts in this area. On the other hand, Alternatives 6.1 and 6.2 would likely cause potentially significant impacts at first-row receivers along the east side of California Avenue SW, north of SW Dawson Street because these alignments in the center and east side of road, respectively, would be closer to residences east of the road. The trains would be traveling at about 40 mph near SW Dawson Street.

SW Dawson Street to SW Raymond Street. Noise modeling indicates that potentially significant noise impacts could occur at first-row residential receivers along the east and west sides of California Avenue SW, within this section of the California subsegment of Alternative 6.1.6(s). Applying the same, more refined speed profile used for Alternative 6.1.6(s) to Alternative 6.1.6 would likely result in the same number of projected noise impacts because of the similarity of these alignments. In contrast, Alternatives 6.1 and 6.2 would likely cause additional noise impacts at first row receivers along the east side of California Avenue SW in this area, and potentially at receivers set back from the roadway because these alternatives are closer to the east side of the road.

SW Raymond Street to SW Holly Street. Noise modeling indicates that potentially significant noise impacts could occur at first-row residential receivers along the west side of California Avenue SW, within this section of the California subsegment of Alternative 6.1.6(s) of the Green Line alignment. Alternative 6.1.6 would likely be projected to cause identical noise impacts in this area if the same speed profile were used because of the similarity of these alignments. Similarly, applying the more refined speed profile, Alternatives 6.1 and 6.2 would likely be projected to cause noise impacts at several first-row receivers east of California Avenue just south of SW Graham Street both because of high travel speeds and because the 6.1 and 6.2 alignments would be closer to residences east of the road.

Table 4.7-15 provides an estimate of the numbers of residential units that could be potentially affected by noise related to the proposed Green Line project. Those portions of the various alternatives that comprise the Preferred Alternative are labeled and highlighted.



Segment 6-West Seattle/PC-C:Drive/554-4481-002/03/01 2/24/04

Figure 4.7-9
Segment 6: West Seattle
SLM and Model Receptor Locations

Table 4.7-15. Numbers of Potentially Impacted Residences by Project Segment and Alternative

Location within Segment	Subsegment Alternative	Notes on Impacts	Impact Type	Approximate # of Impacted Residences
Ballard				
Entire Segment	1.1	First row west of road	Potentially Significant	110
		Second row west of road - with partial shielding from 15th	Moderate	80
		Second row east of, and within 140' of road	Moderate	20
	1.1(s) Preferred	First row west of road	Potentially Significant	29
		Second row west of road	Moderate	24
	1.2	Second row east of, and within 140' of road	Moderate	20
Interbay/Magnolia				
Entire Segment	All Alternatives	No impacts predicted through this segment	No Impacts	0
Queen Anne/ Seattle Center/ Belltown				
West Harrison Street to Seattle Center	3.1 - Preferred	W Harrison Street to Queen Anne First row south of Harrison	Potentially Significant	8
		W Harrison Street to Queen Anne First row north of Harrison	Potentially Significant	18
	3.2	W Harrison Street to Queen Anne First row south of Harrison	Potentially Significant	16
		W Harrison Street to Queen Anne First row north of Harrison	Potentially Significant	18
	3.3 and 3.5 same as 3.1 in this subsegment	W Harrison Street to Queen Anne First row south of Harrison	Potentially Significant	8
		W Harrison Street to Queen Anne First row north of Harrison	Potentially Significant	18
Seattle Center to Virginia Street	All alternatives	No impacts predicted through this subsegment	No Impacts	0
Downtown/Pioneer Square				
Entire Segment	4.1 - Preferred 4.1.1 & 4.1.2	Pike Street to Marion Street First row west of Second Avenue	Potentially Significant	30
	4.2	Pine Street to Pike Street First row east of Second Avenue	Potentially Significant	12
	4.3	No impacts predicted through this segment	No Impacts	0
	4.4	Pine Street to Pike Street First row east of Second Avenue	Potentially Significant	12
SODO/Chinatown International District/Pioneer Square				
Entire Segment	All Alternatives	No impacts predicted through this segment	No impacts	0

Table 4.7-15. Numbers of Potentially Impacted Residences by Project Segment and Alternative (continued)

Location within Segment	Subsegment Alternative	Notes on Impacts	Impact Type	Approximate # of Impacted Residences
		West Seattle		
Duwamish Crossing	All Alternatives Incl. Preferred	No impacts predicted through this subsegment	No Impacts	0
Delridge	6.1	Yancy Street area first row receivers	Potentially Significant	15
	6.2, 6.3(s) – Preferred, 6.4, 6.4(s)	No impacts predicted through this subsegment	No Impacts	0
	6.5	SW Avalon to Delridge Way SW First row north and south of SW Genesee	Potentially Significant	31
Avalon	6.1	No impacts predicted through this subsegment	No Impacts	0
	6.1.3	Fauntleroy Way SW First row receiver north of Fauntleroy	Potentially Significant	2
	6.1.4, 6.2, 6.2.1	No impacts predicted through this subsegment	No Impacts	0
	6.2.2 - Preferred	35th Avenue SW First row west of 35th Avenue SW	Moderate	63
Alaska	6.1	*No impacts predicted through this subsegment*	*No Impacts*	0
	6.2	First row east of 44th Avenue SW	Moderate	12
California	6.1	SW Edmunds to Holly first- and second-row receivers	Potentially Significant	298
	6.1.6	Hudson to Graham First row receivers	Potentially Significant	234
	6.1.6(s) - Preferred	Edmunds to Holly First row receivers West side of California	Potentially Significant	83
		Edmunds to Holly First row receivers East side of California	Potentially Significant	33
	6.2	Hudson to Holly First row receivers	Potentially Significant	296
Estimated Total Numbers of Impacted Residences with Green Line Preferred Alternative				
Green Line Preferred Alternative Alignment			Moderate	87
			Potentially Significant	201

[a] Speed profile and headway information used for all portions of the Preferred Alternative were based on more detailed information than were applied in the previous modeling. Comparisons of impacts among the Preferred Alternative and the other alternatives alignments are therefore not accurate.

Source: Modeling and calculations by MFG, Inc.

4.7.2.3 *Vibration Impact Assessment from Green Line Operations*

Segment 1: Ballard Segment

Potentially sensitive land uses along the Ballard Segment are Residential (vibration impact limit 72 VdB re 1 micro inch/sec) and Institutional (vibration impact limit 75 VdB re 1 micro inch/sec), with no High Sensitivity or Special Buildings along either alignment Alternative 1.1 or 1.2. This section focuses the vibration impact analysis discussion on land use types that are sensitive to vibration as described above in Section 4.7.1.4. Refer to Section 4.3, Land Use and Neighborhoods, for a more complete description of land use impacts to all land use types.

Alternative 1.1 - West Side of 15th

The distance from the centerline of the Green Line alignment Alternative 1.1 to the closest residential receiver property is 12 feet, corresponding to vibration levels of 65.4 VdB re 1 micro inch/sec at the receiver property line. The predicted future vibration levels are below the 72 VdB re 1 micro inch/sec limit for this land use.

The closest Historic Building is B-114, Historic Apartment Building, 1505 NW 60th Street, located 25 feet from the alignment Alternative 1.1. Corresponding vibration levels at the Apartment Building from Green Line operations are below 61.4 VdB re 1 micro inch/sec. Therefore, the predicted future vibration levels are below the 72 VdB re 1 micro inch/sec limit for this land use and well below the limits for architectural damages to extremely fragile historic buildings.

Support columns for the Green Line west bridge Alternative 1.1.1 and far west bridge Alternative 1.1.2 could be placed next to existing offices, with vibration levels at the column base of 74.0 VdB re 1 micro inch/sec. The predicted future vibration levels are below the 75.0 VdB re 1 micro inch/sec limit for Institutional land uses.

Alternative 1.2 - Center of 15th Avenue

The distance from the centerline of the Green Line alignment Alternative 1.2 to the closest residential receiver property is 50 feet, corresponding to a vibration level of 53.4 VdB re 1 micro inch/sec at the property line. The predicted future vibration levels are below the limits for residential land uses.

Building B-114, Historic Apartment Building, 1505 NW 60th Street, is located 50 feet from alignment Alternative 1.2. Corresponding vibration levels at the Apartment Building from monorail operation are 53.4 VdB re 1 micro inch/sec. The predicted future vibration levels are below the limits for this land use and well below the limits for architectural damages to extremely fragile historic buildings.

Support columns for the Green Line east bridge Alternative 1.2 could be placed next to existing commercial buildings, with vibration levels at the column base of 74.0 VdB re 1 micro inch/sec. The predicted future vibration levels are below the 75.0 VdB re 1 micro inch/sec limit for Institutional land use.

The closest Historic Building is B-131, Mike's Chili Parlor, 1447 NW Ballard Way, located 25 feet from alignment Alternative 1.2. Corresponding vibration levels at Mike's Chili Parlor from Green Line operation are below 61.4 VdB re 1 micro inch/sec. The predicted future vibration levels are below the 75 VdB re 1 micro inch/sec threshold for this land use and well below the 95 VdB re 1 micro inch/sec threshold for architectural damages to extremely fragile historic buildings.

Ballard Segment Summary and Preferred Alternative

Since all sensitive land uses are below the maximum vibration threshold, no vibration impacts would be expected with Alternative 1.1 or 1.2. Due to the longer average distance between the Green Line columns and adjacent property, Alternative 1.2 would generate lower overall vibration levels than Alternative 1.1.

The Preferred Alternative for the Ballard Segment would not cause vibration impacts since all sensitive land uses are below the maximum vibration threshold, similar to Alternative 1.1.

Segment 2: Interbay Segment

Potentially sensitive land uses along the Interbay Segment are Residential (vibration impact limit 72 VdB re 1 micro inch/sec) and Institutional (vibration impact limit 75 VdB re 1 micro inch/sec), with three High Sensitivity land uses (vibration impact limit 65 VdB re 1 micro inch/sec) along either alignment Alternative 2.1 or 2.2:

- Friedman & Bruya, Inc., Environmental Chemists, at 3012 16th Avenue W.
- Amgen Campus at 1555 W Galer Street.
- Cell Therapeutics, Inc. at 501 Elliott Avenue West Building.

Alternative 2.1 - West Side of 15th/Center of Elliott

The minimum distance from the centerline of Alternative 2.1 to the closest receiver property is 10 feet, corresponding to vibration levels of 65.4 VdB re 1 micro inch/sec at the receiver property line. The predicted future vibration levels are below the 72.0 VdB limit for Residential and 75.0 VdB limit for Institutional land uses.

Between the Dravus 1 (16th) station alternative and the alignment transition to the west side of 15th Avenue W, the Green Line alignment passes through some residential land uses. Support columns could be placed next to existing structures, with vibration levels at the column base of 74.0 VdB re 1 micro inch/sec. Locating Green Line columns at least 10 feet away from residential land use would reduce vibration levels below the 72 VdB threshold.

The Friedman & Bruya, Inc. site located at 3012 16th Avenue W is a High Sensitivity land use for vibration. The Green Line alignment Alternative 2.1 is located over the northeast corner of the property approximately 20 feet from the building. This would result in vibration levels of 61.4 VdB re 1 micro inch/sec, which is below the 65 VdB re 1 micro inch/sec maximum vibration level for this sensitive receiver.

The Amgen Campus located at 1555 W Galer Street (Pier 88) is also a High Sensitivity land use. The Green Line alignment Alternative 2.1 along the center of Elliott Avenue W is more than 250 feet away from the closest building structure, with vibration levels below 45 VdB re 1 micro inch/sec. This is substantially lower than the 65 VdB threshold for this type of use.

The Cell Therapeutics, Inc. site located at 501 Elliott Avenue West Building is a High Sensitivity land use for vibration. The Green Line alignment Alternative 2.1 along the center of Elliott Avenue W is more than 40 feet from the building. This would result in vibration levels of 55.4 VdB re 1 micro inch/sec, which is substantially below the 65 VdB re 1 micro inch/sec maximum vibration level for this sensitive receiver.

The closest Historic Building is I-74, Ace Tank, 1123c Elliott Avenue W, located 50 feet from alignment Alternative 2.1. Corresponding vibration levels at Ace Tank from Green Line operations are 53.4 VdB re 1 micro inch/sec. The predicted future vibration levels are below the 75 VdB threshold for this land use and well below the 95 VdB threshold for architectural damage to extremely fragile historic buildings.

Alternative 2.1.1 - West Bridge Connection

Support columns for alignment Alternative 2.1.1 could be placed next to existing structures, with vibration levels at the column base of 74.0 VdB re 1 micro inch/sec. The predicted future vibration levels are below the 75 VdB threshold for Institutional land uses.

Alternative 2.1.2 - Far West Bridge Connection

Support columns for alignment Alternative 2.1.2 could be placed next to existing structures, with vibration levels at the column base of 74.0 VdB re 1 micro inch/sec. The predicted future vibration levels are below the 75 VdB threshold for Institutional land uses.

Alternative 2.2 - Center of 15th/West Side of Elliott

The predicted future vibration levels are below the limits for Residential (72 VdB re 1 micro inch/sec) and Institutional land uses (75 VdB re 1 micro inch/sec). The minimum distance from the centerline of alignment Alternative 2.2 to the closest receiver property is 10 feet, corresponding to vibration levels of 65.4 VdB re 1 micro inch/sec at the receiver property line.

The east bridge connection associated with Alternative 2.2 is more than 100 feet away from the closest residential land use, corresponding to a vibration level of 46.4 VdB re 1 micro inch/sec. This is well below the maximum vibration level of 72 VdB re 1 micro inch/sec for residential land use.

Between the Dravus 2 (15th) station alternative and the alignment transition to the center of 15th Avenue W, the distance to the closest structure is 50 feet, corresponding to a vibration level of 53.4 VdB re 1 micro inch/sec. The predicted future vibration levels are below the limits for Residential (72 VdB) and Institutional (75 VdB) land uses.

The Friedman & Bruya, Inc. site located at 3012 16th Avenue W is a High Sensitivity land use. The Green Line alignment Alternative 2.2 is approximately 100 feet away from the building, corresponding to a vibration level of 46.4 VdB re 1 micro inch/sec. This is well below the maximum vibration level of 65 VdB re 1 micro inch/sec for this sensitive receiver.

The Amgen Campus located at 1555 W Galer Street (Pier 88) is also a High Sensitivity land use. The Green Line alignment Alternative 2.2 along the west side of Elliott Avenue W is more than 200 feet away from the closest building structure, with vibration levels well below 45 VdB re 1 micro inch/sec. This is substantially lower than the 65 VdB threshold for this land use type.

The Cell Therapeutics, Inc. site located at 501 Elliott Avenue West Building is a High Sensitivity land use for vibration. The Green Line alignment Alternative 2.2 along the west side of Elliott Avenue W is approximately 20 feet from the building. This would result in vibration levels of 61.4 VdB re 1 micro inch/sec, which is below the 65 VdB re 1 micro inch/sec maximum vibration level for this sensitive receiver.

The closest Historic Building is I-74, Ace Tank, 1123c Elliott Avenue W, located 25 feet from alignment Alternative 2.2. Corresponding vibration levels at Ace Tank from Green Line operations are below 61.4 VdB re 1 micro inch/sec. The predicted future vibration levels are below the 75 VdB threshold for this

land use and well below the 95 VdB threshold for architectural damages to extremely fragile historic buildings.

Interbay Segment Summary and Preferred Alternative

Since all sensitive land uses are below the maximum vibration thresholds, no vibration impacts would be expected with Alternative 2.1 or 2.2. Due to the longer average distance between Green Line columns and adjacent properties (including the Friedman & Bruya, Inc. sensitive receiver), Alternative 2.2 has a lower overall vibration impact than Alternative 2.1.

The Preferred Alternative for the Interbay Segment would not cause vibration impacts since all sensitive land uses are below the maximum vibration threshold.

Segment 3: Queen Anne/Seattle Center/Belltown Segment

Potentially sensitive land uses along the Queen Anne/Seattle Center/Belltown Segment are Residential (vibration impact limit 72 VdB re 1 micro inch/sec) and Institutional (vibration impact limit 75 VdB re 1 micro inch/sec) with three Special Buildings (vibration impact limit 65 VdB re 1 micro inch/sec for Concert Halls, and 72 VdB re 1 micro inch/sec for Theaters), and one High Sensitivity land use (vibration impact limit 65 VdB re 1 micro inch/sec) along Green Line alignment Alternatives 3.1, 3.2, 3.3, or 3.5.

- Pacific Biometrics, Inc. at 220 West Harrison Street.

Alternative 3.1 - Seattle Center/Republican

The minimum distance from the centerline Green Line alignment Alternative 3.1 to the closest receiver property is 10 feet, corresponding to vibration levels of 65.4 VdB re 1 micro inch/sec at the receiver property line. The predicted future vibration levels are below the limits for Residential (72 VdB) and Institutional (75 VdB) land uses.

On W Harrison Street between Elliott Avenue W and First Avenue N, alignment Alternative 3.1 is located adjacent to residential uses with vibration levels at the column base of 74.0 VdB re 1 micro inch/sec. Locating columns 10 or more feet away from these residential structures would reduce vibration levels to 59.8 VdB, well below the threshold of 72 VdB.

The Pacific Biometrics, Inc. site located at 220 West Harrison Street is a High Sensitivity land use for vibration. The Green Line alignment Alternative 3.1 along the south side of Harrison is more than 40 feet from the building. This would result in vibration levels of 55.4 VdB re 1 micro inch/sec, which is substantially below the 65 VdB re 1 micro inch/sec maximum vibration level for this sensitive receiver.

Between Broad Street and Fifth Avenue, alignment Alternative 3.1 would be adjacent to structures with institutional land uses. With the predicted vibration levels at the base of the support columns being 74.0 VdB re 1 micro inch/sec, vibration levels are below the limits for institutional land uses.

The Bagley Wright Theater and Intiman Theater are both located 140 feet from alignment Alternative 3.1, corresponding to vibration levels below 46.4 VdB re 1 micro inch/sec. The predicted future vibration levels are well below the maximum 72 VdB vibration levels for theaters. Therefore, no vibration impacts to the Bagley Wright Theater and Intiman Theater are expected.

The Marion Oliver McCaw Hall is located more than 250 feet away from alignment Alternative 3.1, corresponding to vibration levels below 45.0 VdB re 1 micro inch/sec. The predicted future vibration

levels are well below the maximum 72 VdB vibration levels for concert halls. Therefore, no vibration impact to the Marion Oliver McCaw Hall is expected.

The closest Historic Building is SC-15, Center House at Seattle Center, located 15 feet from alignment Alternative 3.1. Corresponding vibration levels at the Historic Building from monorail operation are below 65.4 VdB re 1 micro inch/sec. The predicted future vibration levels are below the limits for this land use and well below the 95 VdB limit for architectural damages to extremely fragile historic buildings.

Alternative 3.1.1 - Through EMP

With the Green Line going through the EMP, the vibration levels at the outer edge of the building approximately 10 feet away from the base of the columns are predicted to be 65.4 VdB re 1 micro inch/sec. The predicted future vibration levels are below the 72 VdB limit for theaters. Therefore, no vibration impact to the EMP is expected.

No increase of the vibration levels inside the EMP would be expected since the existing monorail currently goes through EMP on a similar alignment. With the new Green Line train and guideway design, the vibration impact to the EMP would be lower than current levels.

Alternative 3.1.2 - Around EMP

The minimum distance from the centerline of Green Line alignment Alternative 3.1.2 to the closest receiver property is 10 feet, corresponding to vibration levels of 65.4 VdB re 1 micro inch/sec at the receiver property line. The predicted future vibration levels are below the 72 VdB threshold for theaters.

Alternative 3.2 - Mercer

The minimum distance from the centerline of Green Line alignment Alternative 3.2 to the closest receiver property is 10 feet, corresponding to vibration levels of 65.4 VdB re 1 micro inch/sec at the receiver property line. The predicted future vibration levels are below the 72 VdB threshold for Residential and 75 VdB threshold for Institutional land uses.

On W Harrison Street between Elliott Avenue W and First Avenue N, alignment Alternative 3.2 is located adjacent to residential uses with vibration levels at the column base of 74.0 VdB re 1 micro inch/sec. Locating columns 10 or more feet away from these residential structures would reduce vibration levels to 59.8 VdB, well below the 72 VdB threshold.

The Pacific Biometrics, Inc. site located at 220 West Harrison Street is a High Sensitivity land use for vibration. The Green Line alignment Alternative 3.2 along the north side of Harrison is approximately 10 feet from the building. This would result in vibration levels of 65.4 VdB re 1 micro inch/sec, which is marginally above the 65 VdB re 1 micro inch/sec maximum vibration level for this sensitive receiver. It is recommended to space the support columns a minimum of 20 feet from the face of the building which would reduce the overall vibration levels to 61.4 VdB re 1 micro inch/sec below the maximum allowable vibration levels for sensitive receivers.

The Bagley Wright Theater is located 30 feet from alignment Alternative 3.2, corresponding to vibration levels below 58.4 VdB re 1 micro inch/sec. The predicted future vibration levels are well below the 72 VdB threshold for theaters. Therefore, no vibration impact to the Bagley Wright Theater is expected.

The Intiman Theater is located 60 feet from alignment Alternative 3.2, corresponding to vibration levels below 53.4 VdB re 1 micro inch/sec. The predicted future vibration levels are well below the 72 VdB threshold for theaters. Therefore, no vibration impact to the Intiman Theater is expected.

The Marion Oliver McCaw Hall is located more than 60 feet from alignment Alternative 3.2, corresponding to vibration levels below 53.4 VdB re 1 micro inch/sec. The predicted future vibration levels are below the limits for concert halls. Therefore, no vibration impact to the Marion Oliver McCaw Hall is expected.

The closest Historic Building is SC-20, Auditorium Apartments, 605 Fifth Avenue N, located 20 feet from the alignment Alternative 3.2. Corresponding vibration levels at the Historic Building from monorail operation are 61.4 VdB re 1 micro inch/sec. The predicted future vibration levels are below the 72 VdB threshold for this land use and well below the 95 VdB threshold for architectural damages to extremely fragile historic buildings.

Alternative 3.3 - Thomas

The minimum distance from the centerline of the Green Line alignment Alternative 3.3 to the closest receiver property is 10 feet, corresponding to vibration levels of 65.4 VdB re 1 micro inch/sec at the receiver property line. The predicted future vibration levels are below the 72 VdB threshold for Residential and 75 VdB threshold for Institutional land uses.

On W Harrison Street between Elliott Avenue W and First Avenue N, alignment Alternative 3.3 is located adjacent to residential uses with vibration levels at the column base of 74.0 VdB re 1 micro inch/sec. Locating columns 10 or more feet away from these residential structures would reduce vibration levels to below the 72.0 VdB threshold for this use.

Pacific Biometrics, Inc. site, same as Alternative 3.1.

No vibration impact to Bagley Wright Theater, Intiman Theater, or Marion Oliver McCaw Hall would be expected with alignment Alternative 3.3.

The closest Historic Building is SC-7, 7 Queen Anne Avenue N, located 25 feet from the alignment Alternative 3.3. Corresponding vibration levels at the Historic Building from monorail operation are below 61.4 VdB re 1 micro inch/sec. The predicted future vibration levels are below the 72 VdB threshold for this land use and well below the 95 VdB threshold for architectural damages to extremely fragile historic buildings.

Alternative 3.5 - Second/Denny

The minimum distance from the centerline of the Green Line alignment Alternative 3.5 to the closest receiver property is 10 feet, corresponding to vibration levels of 65.4 VdB re 1 micro inch/sec at the receiver property line. The predicted future vibration levels are below the 72 VdB threshold for Residential and 75 VdB threshold for Institutional land uses.

On W Harrison Street between Elliott Avenue W and First Avenue N, alignment Alternative 3.5 is located adjacent to residential uses, with vibration levels at the column base of 74.0 VdB re 1 micro inch/sec. Locating columns 10 or more feet away from these residential structures would reduce vibration levels to below the 72.0 VdB threshold for this use.

Pacific Biometrics, Inc. site, same as Alternative 3.1.

The Seattle Children's Theater is located 50 feet from alignment Alternative 3.5, corresponding to vibration levels of 53.4 VdB re 1 micro inch/sec. The predicted future vibration levels are below the 72 VdB threshold for theaters. Therefore, no vibration impact to the Seattle Children's Theater is expected.

Fisher Pavilion is located 50 feet from alignment Alternative 3.5, corresponding to vibration levels below 53.4 VdB re 1 micro inch/sec. The predicted future vibration levels are below the 65 VdB threshold for recording studios. Therefore, no vibration impact to Fisher Pavilion is expected.

No vibration impact to Bagley Wright Theater, Intiman Theater, or Marion Oliver McCaw Hall would be expected with Alternative 3.5.

The closest Historic Building is SC-7, 7 Queen Anne Avenue N, located 25 feet from alignment Alternative 3.5. Corresponding vibration levels at the Historic Building from monorail operation are below 61.4 VdB re 1 micro inch/sec. The predicted future vibration levels are below the 72 VdB threshold for this land use and well below the 95 VdB threshold for architectural damage to extremely fragile historic buildings.

Queen Anne/Seattle Center/Belltown Segment Summary and Preferred Alternative

Since all sensitive land uses are below the maximum vibration thresholds, no vibration impacts would be expected with Alternatives 3.1, 3.2, 3.3, or 3.5. Due to the longer distance between Green Line columns and sensitive receivers in this segment, Alternatives 3.3 and 3.5 would generate the lowest vibration levels of all alternatives. The highest overall vibration level would occur with Alternative 3.2 due to its close proximity to Pacific Biometrics Inc. and Seattle Center theaters, although this alternative would not result in vibration impacts as long as columns are located a minimum of 20 feet from the building.

The Preferred Alternative for the Queen Anne/Seattle Center/Belltown Segment would not cause vibration impacts since all sensitive land uses are below the maximum vibration threshold, similar to Alternative 3.1.

Segment 4: Downtown Segment

Potentially sensitive land uses along the Downtown Segment are Residential (vibration impact limit 72 VdB re 1 micro inch/sec) and Institutional (vibration impact limit 75 VdB re 1 micro inch/sec) with three Special Buildings (vibration impact limit 65 VdB re 1 micro inch/sec for Concert Halls) along Green Line alignment Alternatives 4.1, 4.2, and 4.3.

Alternative 4.1 - West Side of Second

Along Second Avenue, alignment Alternative 4.1 would be adjacent to existing structures where residential land uses exist. The minimum distance from the centerline of Alternative 4.1 to the closest receiver property is 10 feet, corresponding to vibration levels of 65.4 VdB re 1 micro inch/sec at the receiver property line. The predicted future vibration levels are below the 72 VdB threshold for Residential and 75 VdB threshold Institutional land uses. There is no difference in impacts for alignment Options 4.1.1 and 4.1.2.

Benaroya Hall is located 60 feet from alignment Alternative 4.1, corresponding to vibration levels below 53.4 VdB re 1 micro inch/sec. The predicted future vibration levels are well below the maximum 65 VdB vibration levels for concert halls. Therefore, no vibration impact to Benaroya Hall is expected.

The Moore Theater is located 100 feet from alignment Alternative 4.1, corresponding to vibration levels of 46.4 VdB re 1 micro inch/sec. The predicted future vibration levels are well below the maximum 72 VdB vibration threshold for theaters. Therefore, no vibration impact to the Moore Theater is expected.

Seattle Art Museum is located 20 feet from the alignment Alternative 4.1, corresponding to vibration levels of 61.4 VdB re 1 micro inch/sec. The predicted future vibration levels are below the maximum 72 VdB vibration threshold for auditoriums. Therefore, no vibration impact to the Seattle Art Museum is expected.

The closest Historic Building is D-34, Times Square Building, 414 Olive Way, located 15 feet from alignment Alternative 4.1. Corresponding vibration levels at this Historic Building from Green Line operations are below 65.4 VdB re 1 micro inch/sec. The predicted future vibration levels are below the 72 VdB threshold for this land use and well below the 95 VdB threshold for architectural damage to extremely fragile historic buildings.

The closest Areaways are 407, 406, 601, 1003, 1004, 1005, and 6001, all located within 10 feet of the alignment Alternative 4.1. Corresponding vibration levels at the Areaways from Green Line operations are 65.4 VdB re 1 micro inch/sec. The predicted future vibration levels are well below the 95 VdB threshold for architectural damage to extremely fragile historic buildings.

Alternative 4.2 - East Side of Second with Crossover

The minimum distance from the centerline of alignment Alternative 4.2 to the closest receiver property is 15 feet, corresponding to vibration levels of 63.4 VdB re 1 micro inch/sec at the receiver property line. The predicted future vibration levels are below the 72 VdB threshold for Residential and 75 VdB threshold for Institutional land uses.

Benaroya Hall is located 15 feet from alignment Alternative 4.2, corresponding to a vibration level of 63.4 VdB re 1 micro inch/sec. The predicted future vibration levels are below the 65 VdB vibration threshold for concert halls. Therefore, no vibration impact to Benaroya Hall is expected.

The Moore Theater is located more than 100 feet from alignment Alternative 4.2, corresponding to vibration levels below 46.4 VdB re 1 micro inch/sec. The predicted future vibration levels are well below the maximum 65 VdB vibration threshold for theaters. Therefore, no vibration impact to the Moore Theater is expected.

Seattle Art Museum is located 50 feet from alignment Alternative 4.2, corresponding to vibration levels of 53.4 VdB re 1 micro inch/sec. The predicted future vibration levels are below the 72 VdB maximum vibration threshold for auditoriums. Therefore, no vibration impact to the Seattle Art Museum is expected.

The closest Historic Building is D-34, Times Square Building, 414 Olive Way, located 15 feet from the alignment Alternative 4.2. Corresponding vibration levels at this Historic Building from Green Line operations are below 65.4 VdB re 1 micro inch/sec. The predicted future vibration levels are below the 72 VdB threshold for this land use and well below the limits for architectural damages to extremely fragile historic buildings.

The closest Areaways are 407, 406, 601, 1003, 1004, 1005, and 6001, all located within 10 feet of alignment Alternative 4.2. Corresponding vibration levels at the Areaways from Green Line operations are 65.4 VdB re 1 micro inch/sec. The predicted future vibration levels are well below the 95 VdB threshold for architectural damages to extremely fragile historic buildings.

Alternative 4.3 - Center of Second

The minimum distance from the centerline of alignment Alternative 4.3 to the closest receiver property is 40 feet, corresponding to vibration levels of 55.4 VdB re 1 micro inch/sec at the receiver property line. The predicted future vibration levels are below the 72 VdB threshold for Residential and 75 VdB threshold for Institutional land uses.

Benaroya Hall is located 40 feet from alignment Alternative 4.3, corresponding to a vibration level of 55.4 VdB re 1 micro inch/sec. The predicted future vibration levels are well below the 65 VdB threshold for concert halls.

The Moore Theater is located more than 100 feet from alignment Alternative 4.3, corresponding to vibration levels below 46.4 VdB re 1 micro inch/sec. The predicted future vibration levels are well below the maximum 72 VdB vibration levels for theaters. Therefore, no vibration impact to the Moore Theater is expected.

Seattle Art Museum is located 30 feet from alignment Alternative 4.2, corresponding to vibration levels of 58.4 VdB re 1 micro inch/sec. The predicted future vibration levels are below the maximum 72 VdB vibration threshold for auditoriums. Therefore, no vibration impact to the Seattle Art Museum is expected.

The closest Historic Building is D-126, King Street Station, 301 S Jackson Street, located 30 feet from alignment Alternative 4.3. Corresponding vibration levels at the Historic Building from monorail operation are 58.4 VdB re 1 micro inch/sec. The predicted future vibration levels are below the 75 VdB threshold for this land use and well below the 95 VdB threshold for architectural damages to extremely fragile historic buildings.

The closest Areaways are 407, 406, 601, 1003, 1004, 1005, and 6001, all located within 10 feet of alignment Alternative 4.3. Corresponding vibration levels at the Areaways from monorail operation are 65.4 VdB re 1 micro inch/sec. The predicted future vibration levels are well below the 95 VdB threshold for architectural damages to extremely fragile historic buildings.

Alternative 4.4 – East Center of Second

The minimum distance from the Centerline of alignment Alternative 4.4 to the closest receiver property is approximately 25 feet corresponding to vibration levels of 59.9 VdB re 1 micro inch/sec. at the receiver property line. The predicted future vibration levels are below the 65 VdB threshold for special buildings such as concert halls and theaters.

Downtown Segment Summary and Preferred Alternative

Since all sensitive land uses are below the maximum vibration threshold, no vibration impacts would be expected with Alternatives 4.1, 4.2, 4.3 or 4.4. The Preferred Alternative for the Downtown Segment would not cause vibration impacts since all sensitive land uses are below the maximum vibration threshold.

Segment 5: SODO Segment

Potentially sensitive land uses along the SODO Segment are mostly Institutional (vibration impact limit 75 VdB re 1 micro inch/sec) with some Residential (vibration impact limit 72 VdB re 1 micro inch/sec). The Pioneer Square Historic District, including King Street Station, is located at the north end of this segment.

Alternative 5.1 - East Side of Third/Utah

The minimum distance from the centerline of alignment Alternative 5.1 to the closest receiver property is 10 feet, corresponding to vibration levels of 65.4 VdB re 1 micro inch/sec at the receiver property line. The predicted future vibration levels are below the limits for Residential and Institutional land uses. There is no difference in vibration impact for alignment Options 5.1.1 and 5.1.2.

The closest Historic Building is S-58, Markey Machinery Co., 79 S Horton Street, located 40 feet from alignment Alternative 5.1. Corresponding vibration levels at the Historic Building from Green Line operations are 55.4 VdB re 1 micro inch/sec. The predicted future vibration levels are below the 75 VdB threshold for this land use and well below the 95 VdB threshold for architectural damage to extremely fragile historic buildings.

Alternative 5.2 - West Side of Third/Utah

The minimum distance from the centerline of alignment Alternative 5.2 to the closest receiver property is 40 feet, corresponding to vibration levels of 55.4 VdB re 1 micro inch/sec at the receiver property line. The predicted future vibration levels are below the 72 VdB threshold for Residential and 75 VdB threshold for Institutional land uses.

The closest Historic Building is S-61, Rainier Cold Storage Building, on the southeast corner of S Horton Street and Colorado Avenue S, located 40 feet from alignment Alternative 5.2. Corresponding vibration levels at the Historic Building from Green Line operations are 55.4 VdB re 1 micro inch/sec. The predicted future vibration levels are below the 72 VdB threshold for this land use and well below the 95 VdB threshold for architectural damages to extremely fragile historic buildings.

SODO Segment Summary and Preferred Alternative

Since all sensitive land uses are below the maximum vibration threshold, no vibration impacts would be expected with Alternatives 5.1 and 5.2. The Preferred Alternative for the SODO Segment would not cause vibration impacts since all sensitive land uses are below the maximum vibration threshold.

Segment 6: West Seattle Segment

Land uses along the West Seattle Segment are Residential (vibration impact limit 72 VdB re 1 micro inch/sec) and Institutional (vibration impact limit 75 VdB re 1 micro inch/sec) with no High Sensitivity or Special Buildings along the alignments.

Alternative 6.1 - West Seattle I

The minimum distance from the centerline of alignment Alternative 6.1 to the closest receiver property is 10 feet, corresponding to vibration levels of 65.4 VdB re 1 micro inch/sec at the receiver property line. The predicted future vibration levels are below the 72 VdB threshold for Residential and 72 VdB threshold for Institutional land uses.

The Arts West Theater is located more than 200 feet from the Alternative Alignment 6.1, corresponding to vibration levels below 46.4 VdB re 1 micro inch/sec. The predicted future vibration levels are well below the maximum 72 VdB vibration threshold for theaters. Therefore, no vibration impact to the Arts West Theater is expected.

Along California Avenue SW, the minimum distance from the centerline of alignment Alternative 6.1 to the closest receiver property is 30 feet, corresponding to vibration levels of 58.4 VdB re 1 micro inch/sec

at the receiver property line. The predicted future vibration levels are below the 72 VdB threshold for residential and 75 VdB threshold for institutional land uses.

The closest Historic Building is WS-154, Residence, 5956-5958 California Avenue SW, located 40 feet from alignment Alternative 6.1. The corresponding vibration level at this Historic Building from Green Line operations is 55.4 VdB re 1 micro inch/sec. The predicted future vibration levels are below the 72 VdB threshold for this land use and well below the 95 VdB threshold for architectural damage to extremely fragile historic buildings.

Alternative 6.2 – West Seattle II

The minimum distance from the centerline of alignment Alternative 6.2 to the closest receiver property is 10 feet, corresponding to vibration levels of 65.4 VdB re 1 micro inch/sec at the receiver property line. The predicted future vibration levels are below the 72 VdB threshold for Residential and 75 VdB threshold Institutional land uses.

The Arts West Theater is located 50 feet from alignment Alternative 6.2, corresponding to vibration levels of 53.4 VdB re 1 micro inch/sec. The predicted future vibration levels are below the maximum 72 VdB vibration threshold for theaters. Therefore, no vibration impact to the Arts West Theater is expected.

Along California Avenue SW, the minimum distance from the centerline of Alternative 6.2 to the closest receiver property is 10 feet, corresponding to vibration levels of 65.4 VdB re 1 micro inch/sec at the receiver property line. The predicted future vibration levels are below the 72 VdB threshold for Residential and 75 VdB threshold for Institutional land uses.

The closest Historic Building is WS-154, Residence, 5956-5958 California Avenue SW, located 20 feet from alignment Alternative 6.2. The corresponding vibration levels at this Historic Building from Green Line operations are 61.4 VdB re 1 micro inch/sec. The predicted future vibration levels are below the 72 VdB threshold for this land use and well below the 95 VdB threshold for architectural damages to extremely fragile historic buildings.

Alternative 6.3(s) – Delridge North Subsegment – Preferred Alternative

The minimum distance for the Centerline of alignment Alternative 6.3(s) to the closest receiver property is 10 feet, corresponding to vibration levels of 65.4 VdB re 1 micro inch/sec. at the receiver property line. The predicted future vibration levels are below the 72 VdB threshold for residential land uses in this area.

Alternative 6.4 – West Seattle Andover/Yancy Subsegment

The minimum distance for the Centerline of alignment Alternative 6.4 to the closest receiver property is 10 feet, corresponding to vibration levels of 65.4 VdB re 1 micro inch/sec. at the receiver property line. The predicted future vibration levels are below the 72 VdB threshold for residential land uses in this area.

Alternative 6.5 – Genesee Subsegment

The minimum distance for the Centerline of alignment Alternative 6.5 to the closest receiver property is 10 feet, corresponding to vibration levels of 65.4 VdB re 1 micro inch/sec. at the receiver property line. The predicted future vibration levels are below the 72 VdB threshold for residential land uses in this area.

West Seattle Segment Summary and Preferred Alternative

Since all sensitive land uses are below the maximum vibration threshold, no vibration impacts would be expected with Alternatives 6.1, 6.2, 6.3(s), 6.4, or 6.5. The increased distance along California Avenue SW from the centerline of alignment Alternative 6.1 to the closest building structures results in a lower overall impact of this alignment compared with Alternative 6.2 or 6.1.6. All of the alignment options in the West Seattle Segment (6.1.1, 6.1.2, 6.1.3, and 6.1.4) would result in similar vibration impacts.

With the single beam alignment alternatives, the vibration levels from operation will be lower than the dual beam configuration. The decrease of the vibration amplitude from two trains at maximum speed crossing at an expansion gap to one train is 6 VdB re 1 micro inch/sec. Therefore, the already low operational vibration levels would be even lower with this single beam configuration exists.

Switches north and south of the stations transitioning from a single to a dual beam configuration are necessary for operation. Both "Beam Replacement Switches" and "Segmented Pivot Type Switches" will move beam sections between the two main beams before and after the stations. The switches are moving the beam sections at a very low speed, for instance the Walt Disney World monorail beam replacement switches cycle in twelve seconds, reducing the dynamic switching forces to well below of the operational. ("The Switch Myth" by Kim Pedersen http://www.monorails.org/tMspages/switch.html).

Assuming the trains are not going faster than 15 mph entering and leaving a station, the vibration levels due to the reduced speed are calculated to be 10 VdB re 1 micro inch/sec lower than one train at 50 mph, see Chapter 10: General Vibration Assessment, Page 7 – FTA Final Report 1995. This would bring the overall vibration levels from the original two beam, two train model down a total of 16 VdB re 1 micro inch/sec.

Summary:

All areas evaluated for single beam configuration will generate equal or lower vibration levels than the original alignments evaluated in Section 4.7.2.3. The single beam segments limit the traffic to one train at a time and therefore also reduce the vibration impact levels resulting from two trains passing at the same time.

All Station Alternatives

At all stations, vibration levels at the base of the support columns would be below the maximum vibration levels for High Sensitivity land uses (65 VdB re 1 micro inch/sec) due to the reduced train speed approaching and leaving the station. Therefore, no vibration impacts from Green Line operations are expected at stations.

Ground-borne vibration levels vary at approximately 20 times the logarithm of the speed of the train. This means that doubling the train speed would increase the vibration levels approximately 6 VdB re 1 micro inch/sec and halving the speed would reduce the level by 6 VdB re 1 micro inch/sec. Table 4.7-16 shows the predicted vibration levels at stations under a variety of operating conditions.

4.7.2.4 Noise and Vibration Impacts from Construction

Construction of the Green Line would generate various noise and vibration impacts depending on the type of equipment used, distance to closest receivers, and soil conditions. Refer to Section 4.17, Construction, for the construction noise and vibration impact analysis and mitigation measures.

Table 4.7-16. Predicted Vibration Levels at Stations

Description	Vibration Level
Two trains at 25 mph in opposite direction with maximum braking	73.8 VdB
Two trains at 25 mph in opposite direction with maximum acceleration	73.9 VdB
At column base two trains at 25 mph in opposite direction with maximum braking	63.8 VdB
At column base two trains at 25 mph in opposite direction with maximum acceleration	63.9 VdB
At column base two trains at 10 mph in opposite direction with maximum braking	55.8 VdB
At column base two trains at 10 mph in opposite direction with maximum acceleration	55.9 VdB
At column base two trains at 5 mph in opposite direction with maximum braking	49.8 VdB
At column base two trains at 5 mph in opposite direction with maximum acceleration	49.9 VdB

RMS velocity Levels, VdB re 1 micro inch/sec.

4.7.2.5 No Action Alternative Impacts

The No Action Alternative would not create noise or vibration impacts to any buildings adjacent to the Green Line corridor.

4.7.3 Mitigation

4.7.3.1 Noise Mitigation

Because the noise analysis identified potential impacts associated with Green Line alternatives, it is necessary to consider mitigation measures to reduce or eliminate such impacts. The following section considers potential mitigation measures that could be implemented to reduce noise impacts related to operation of the Green Line. For discussion of the mitigation measures related to potential impacts related to construction noise, refer to Section 4.17, Construction.

Based on the modeling assessment conducted for this evaluation, it was preliminarily determined that sound levels from Green Line trains could need to be reduced from 3 to 14 dBA to avoid impacts at all residential use locations along the alternative alignments. There appear to be a number of potential methods of reducing noise transmission from the trains. These could include one or more of the following measures:

- Creating design specifications for train cars that limit their noise levels by incorporating shielding of noise-producing areas or absorptive materials, or by other means.
- Creating design specifications for guideways and stations that enable them to block noise from Green Line trains by incorporating blocking or absorptive materials or by other means.
- Reducing travel speeds in sensitive areas. The noise impact evaluation conducted for the Preferred Alternative presented in the Final EIS used refined assumptions about speed and headways, which reduced projections of noise impacts. Further reductions in speed are unlikely.
- Providing insulating or absorptive materials or other means of shielding to dampen sound penetration to nearby properties.

This EIS presents a reasonable maximum impact scenario for noise based upon extensive analysis and modeling. After the start of operations, noise monitoring will confirm the actual noise levels at sensitive receptors and the effectiveness of mitigation measures and allow for verifiable adjustments. Actual noise impacts could be well below predicted levels.

Table 4.7-17 presents findings of some of the initial considerations of possible noise mitigation measures for the Green Line. Based on this review, it appears highly likely that effective noise mitigation measures could be developed and implemented once the alignment of the Green Line has been decided.

Table 4.7-17. Potential Noise Control Mitigation Measures

Method	Possible Effects	Comments
Travel speed reductions over entire day in impact areas	Direct reduction of noise associated with tire noise on the guideway. Preliminary examination indicates reductions of about 2.3 dBA for each 5 mph reduction. Reducing speed at all times by 5 mph would reduce Ldn by about 2.3 dBA.	Would affect performance of system. Would provide sufficient reduction to avoid impacts in some areas.
Travel speed reductions during some noise-sensitive nighttime hours	Reducing speed 10 mph during hours of 2200-2400 and 0500-0600 reduces Ldn about 1.4 dBA	Would not affect peak use hours, but would not have much effect on daylong sound levels. Would provide sufficient reduction to avoid impacts in a few areas.
Travel speed reductions during all noise-sensitive nighttime hours	Reducing speed 10 mph during hours of 2200-2400 and 0500-0700 reduces Ldn about 2.7 dBA	Would affect one peak use hour, but would have somewhat greater effect on daylong sound levels. Would provide sufficient reduction to avoid impacts in some areas. The evaluation of the Preferred Alternative in the Final EIS used a refined speed profile and modified headway assumptions, which reduced impacts; further speed reductions are unlikely
Travel speed reductions (5 mph) over entire day in impact areas AND 5 mph reductions during some or all noise-sensitive nighttime hours	Reducing the speed 5 mph over the entire day and also reducing the speed an additional 5 mph during 3 nighttime hours reduces the Ldn by 3.1 dBA [-3.8 dBA with all four nighttime hours]	Would provide sufficient reduction to avoid impacts in some areas. Most effective scenario affects one peak use hour.
Travel speed reductions (5 mph over entire day in impact areas AND 10 mph reductions during some or all noise-sensitive nighttime hours	Reducing the speed 5 mph over the entire day and also reducing the speed an additional 10 mph during 3 nighttime hours reduces the Ldn by 3.7 dBA [-5.0 dBA with all four nighttime hours]	Would provide sufficient reduction to avoid impacts in many areas. Most effective scenario affects one peak use hour.
Using quietest available onboard equipment and treating the equipment and/or the equipment compartments to control noise	Could provide substantial reductions in uncontrolled levels of equipment-related sound levels. This type of control is very feasible.	Most effect in noise reductions for trains moving at slower speeds and at stations.
Adding mass and/or additional skirting to reduce transmission of tire noise	This sort of control is largely undocumented.	Significant control of tire noise may be possible, but raises the issue of additional weight.
Guideway noise barriers	Could provide substantial reductions if strategically placed.	Could be unsightly and would add weight to the guideway.
Noise control measures to reduce interior sound levels in sensitive uses that would otherwise be affected	Could substantially reduce interior levels; has no effect on exterior levels.	Retrofits require custom applications, are labor intensive, and can be expensive.
Combination of the above	Could provide substantial noise reductions.	Requires more complete analysis based on the actual design of the Green Line and development of information regarding the guideway horizontal and vertical alignments and the physical geometry of nearby land and buildings.

Source: MFG, Inc. and Lea & Elliott

4.7.3.2 *Vibration Mitigation*

The purpose of vibration mitigation is to minimize adverse effects that ground-borne vibration could have to adjacent properties. This section describes mitigation measures that could be implemented for vibration impacts.

For all Green Line alignment alternatives, a minimum 10-foot separation from support columns to any residential land use would reduce the vibration level to 65.4 VdB re 1 micro inch/sec, below the residential vibration threshold of 72 VdB. Since columns are expected to be located at least 10 feet away from residential land uses for any of the Green Line alternatives, no additional mitigation would be required.

For high sensitivity land uses such as Friedman & Bruya, Inc. at 3012 16th Avenue W in the Interbay Segment and Pacific Biometrics, Inc. at 220 W Harrison Street in the Queen Anne segment, a 20-foot separation from the closest support column to the existing building would result in a vibration level of 61.4 VdB re 1 micro inch/sec. This is lower than the 65 VdB re 1 micro inch/sec maximum vibration level for these sensitive receivers. Therefore, no additional mitigation would be required since columns for Alternatives 2.1 and 3.1 would be located at least 20 feet from the building.

In addition, an effective maintenance program should be implemented for controlling ground-borne vibration. This should include standard vehicle maintenance checks on the vehicle tires, tire pressure, and suspension system. A regular check of the guideway surfaces should also be part of the structural maintenance program to maintain a smooth concrete surface for Green Line trains to ride on.

4.7.4 Significant Unavoidable Adverse Impacts

Without effective implementation of mitigation measures, operational noise from the Green Line could cause significant noise impacts at numerous residences along the proposed route. Potentially significant noise impacts have been identified in the following areas: along 15th Avenue NW in Ballard; along W Harrison Street, and along Fifth Avenue between Bell and Lenora Streets in the Queen Anne/Seattle Center/Belltown Segment; along Second Avenue between Pine and Marion Streets in the Downtown Segment; and in West Seattle along SW Yancy Street, along Genesee Street in the Delridge area, and along California Avenue SW between SW Hudson and SW Holly Streets.

For the Preferred Alternative, potential areas of adverse noise impacts include the following areas: along 15th Avenue NW in Ballard; along W Harrison Street in the Queen Anne/Seattle Center/Belltown Segment; along Second Avenue between Pike and Marion Streets in the Downtown Segment; and in West Seattle along California Avenue SW between SW Dawson and SW Holly Streets.

No significant unavoidable adverse vibration impacts are expected with the construction or operation of the Green Line.

4.8 ENERGY

This section summarizes current transportation-related energy use in the Puget Sound region and quantifies the future operational and construction energy use from the Green Line.

4.8.1 Affected Environment

This analysis focuses on existing transportation-related energy use in the Puget Sound region. For the affected environment, the transportation energy analysis identifies energy consumed by automobiles, trucks, buses, and motorcycles (not including boats, trains, and planes). Table 4.8-1 summarizes the average daily energy consumption for transportation uses in the Puget Sound region (Seattle-Everett and Tacoma urbanized areas) in 2001. Vehicle miles traveled (VMT) was estimated for the Puget Sound region by the Puget Sound Regional Council (PSRC). Vehicle mix and average fuel consumption data were used with multipliers from the Transportation Energy Data Book (U.S. Department of Energy 2002) to estimate daily energy consumption for the region. Average weekday regional VMT used approximately 499.089 x 10^9 British thermal units (Btu) of energy in 2001. Energy is also consumed to maintain and repair vehicles (oil, tires, and general maintenance and repair) and can also be calculated using VMT and multipliers from the Transportation Energy Data Book. Vehicle maintenance adds 70.694 x 10^9 Btu to daily regional energy consumption.

Transportation-related energy use within Seattle consists of automobiles, trucks, buses, motorcycles, trains, and ferries. Most vehicles are powered by gasoline and diesel. Nineteen King County Metro trolley bus routes are powered by electricity.

Table 4.8-1. Existing Motor Vehicle Energy Consumption in the Puget Sound Region (2001)

Vehicle Type	Percent of VMT[a]	Daily VMT[b]	Average Fuel Consumption (miles per gallon)[a]	Daily Fuel Consumption (gallons)	Daily Energy Consumption (Btu x 10^9)
Light-duty gas automobiles	47.3	31,176,460	23.61	1,320,477	165.060
Light-duty gas trucks 1	26.9	17,732,111	18.53	956,941	119.618
Light-duty gas trucks 2	11.5	7,577,881	14.21	533,278	66.660
Heavy-duty gas vehicles	4.5	2,974,668	7.87	378,096	47.262
Light-duty diesel automobiles	0.1	84,252	26.41	3,190	0.442
Light-duty diesel trucks	0.2	153,276	19.23	7,971	1.106
Heavy-duty diesel vehicles	9.0	5,906,089	8.35	707,570	98.140
Motorcycles	0.5	320,264	50.00	6,405	0.801
Subtotal	**100**	**65,925,000**		**3,913,928**	**499.089**
Vehicle maintenance					70.694
Total					**569.783**

Notes: Btu per gallon of gasoline = 125,000. Btu per gallon of diesel = 138,700.
Light-duty trucks 1 = Trucks up to 6,000 pounds gross vehicle weight.
Light-duty trucks 2 = Trucks from 6,000 to 8,500 pounds gross vehicle weight.
Heavy-duty trucks = Trucks over 8,500 pounds gross vehicle weight.

[a] Share of vehicle miles traveled (VMT) by vehicle type and average fuel consumption by vehicle type is from Washington State Department of Ecology (Ecology 2003).

[b] VMT was calculated for the Puget Sound Region, which includes the Seattle-Everett and Tacoma urbanized areas (PSRC 2001).

Sources: Ecology (2003); PSRC (2001); U.S. Department of Energy (2002).

4.8.2 Impacts

4.8.2.1 Green Line Alternatives

Direct impacts are characterized by the energy that would be consumed by operation of the Green Line. The energy consumed by the Green Line includes operation of monorail trains, transit stations, equipment rooms, and the Operations Center. Energy for potential guideway heating for snow and ice removal on the guideway surfaces and power/signal rails is also considered, although current plans do not include heating the guideway. The tentative recommendation not to heat the guideway is based on an analysis of monorail operations during inclement weather (Lea+Elliott 2003a). Based on National Weather Data Service 30-year temperature and precipitation averages, the analysis concluded that local weather is not concurrently cold and wet enough to create significant ice formation and necessitate guideway heating. During times when frost or ice is expected to form, operating trains on a normal schedule would be sufficient to keep the guideway clear.

Green Line operational energy use was provided by Lea+Elliott. Lea+Elliott's work explains the results of a preliminary power analysis performed for one of the build alternatives (Lea+Elliott 2003b). The detailed simulation results used to calculate these estimates are provided in an analysis by Lea+Elliott (Lea+Elliott 2003c). In order to determine potential energy usage for the Green Line, an analysis of the individual route and station alternatives is not required because all alternatives, including the Preferred Alternative, would use a similar amount of energy. Total distance traveled, number of stations, grade, and/or curve radii are the main factors in monorail power usage. The alternatives are not different enough with respect to these conditions to have a significant difference in power usage. More favorable power consumption may result if any of the single beam segments are implemented (Harris 2003).

Table 4.8-2 summarizes the projected daily operational energy demand for the Green Line. It is estimated that Green Line operations would use 0.590 x 10^9 Btu daily if there is no guideway heating and 0.593 x 10^9 Btu daily with guideway heating. It is estimated that Green Line-related energy consumption would represent approximately 0.1 percent of the existing regional energy use for transportation, a relatively small percentage of the region's transportation energy use.

Table 4.8-2. Green Line Daily Operational Energy Use in Btu

Type of Energy Use	Daily Energy Use[a]
Train propulsion	0.318
Operations Center	0.123
Stations	0.072
Equipment rooms	0.077
Total Green Line system energy use	**0.590**
Optional guideway heating[b]	0.003
Total Green Line energy use with guideway heating	**0.593**

[a] Values provided in 10^9 Btu.
[b] Guideway heating based on 480 hours of heating.
Source: Lea+Elliott (2003b).

Seattle City Light has indicated that the estimated power demand for the Green Line would not have a major impact on energy resources available to Seattle City Light, however upgrading some transmission lines and power substations may be required to deliver electrical power to where it is needed (Davis 2003). For comparison purposes, Seattle City Light provided monthly energy use for other large-load

electricity customers. On a monthly basis, SMP would consume less than one seventh of the energy used by Nucor Steel, a local steel mill (Seattle City Light 2003).

While the Green Line could consume additional electrical energy over the No Action Alternative, it would reduce the energy consumed by motor vehicles for trips made on the Green Line instead of motor vehicles (see Section 4.1.2, Table 4.1-7 Transportation). As people choose to travel on the Green Line, some vehicle trips would be shortened or eliminated. Although not possible to predict with precision, the energy savings from the reduction in vehicle trips would partially or fully offset the power requirements of the Green Line.

Power rails mounted to the guideway beam supply the electricity used to power the vehicles' electric motors (Lea+Elliott 2003b). The types of electric motors and motor controllers are dependent on the selection of the monorail train supplier. These rails would have either 750 volts Direct Current (DC) or 1,500 volts DC depending on the selected train supplier. Ten to 20 traction power substations would be constructed along the Green Line alignment to distribute power throughout the system. The number of substations would depend on whether all substations are built with redundant power supply (10 substations needed) or whether each has only a single source (20 substations needed) (Lea+Elliott 2003b). Upgrades to some power transmission lines may be required; impacts to transmission lines and other utilities are discussed in Section 4.9, Public Services and Utilities.

SMP is coordinating with Seattle City Light to ensure a reliable source of power for the Green Line and to minimize impacts to Seattle City Light facilities and resources. This reliability would be achieved by Seattle City Light providing redundant (dual) feeders. It is anticipated that the traction power substations will be supplied by common feeders from one or two Seattle City Light sources. The number of sources needed will depend on Seattle City Light's infrastructure at the time the power is needed for the Green Line. Each passenger station and the Operations Center will be powered by separate electrical service connections.

To maximize the power consumption efficiency of the monorail trains and ensure good power quality, the monorail system supplier will be required to maintain a minimum average power factor of 0.95 and to comply with Institute of Electrical and Electronics Engineers, Inc. Standard 519-1992. The peak line load Kilo-Volt-Amperes (KVA) for any 15-minute period and the average KVA demand estimated are provided in Table 4.8-3. Peak energy demand would most likely occur when peak operation times (6:00 a.m. to 9:00 a.m. and 4:00 p.m. to 7:00 p.m.) coincide with periods of extreme weather. The monorail trains would be heated during periods of cold weather and could potentially be air-conditioned during periods of hot weather. In addition, to prevent ice formation on the guideway (if the guideway is not heated), the system would operate on a normal peak period schedule during cold weather periods.

Table 4.8-3. Green Line Operational Energy Use in KVA

	Average KVA	Peak KVA
Train propulsion	15,000	19,000
Operations Center	750	1,500
Stations (including equipment rooms)	5,225	9,500
Total	**20,975**	**30,000**
Guideway power rail heating[a]	3,000	3,000
Total	**23,975**	**33,000**

[a] KVA values for guideway power rail heating are only applicable when the system is turned on during snow/icing conditions.

The monorail train supplier may reduce these peak and average KVA estimates by utilizing regenerative braking (electrical power generation during train deceleration). This generated power would be available for consumption by other trains in the system. Regenerative power is not expected to pass beyond the Seattle City Light point of connection, although it could with Seattle City Light approval. The monorail system supplier would be required to comply with all applicable Seattle City Light codes and regulations for electrical service connections and regenerative power, and all monorail system electrical switchgear would be coordinated with Seattle City Light.

4.8.2.2 No Action Alternative

The No Action Alternative would not require energy for Green Line operations; however, energy savings would not be realized from reduced vehicle trips.

4.8.3 Mitigation

SMP will work with Seattle City Light to implement SMP's environmental sustainability policies as it designs facilities. Where appropriate, electricity conservation measures and electrical system specifications for supply will be implemented. The Green Line would incorporate relevant City of Seattle and Washington State energy code requirements into design where appropriate (for example, energy-efficient lighting, mechanical equipment, and building insulation). No additional measures are necessary to mitigate the anticipated energy use of the Green Line.

4.8.4 Significant Unavoidable Adverse Impacts

No significant unavoidable adverse energy impacts are expected as a result of any of the Green Line Alternatives.

4.9 PUBLIC SERVICES AND UTILITIES

4.9.1 Affected Environment

4.9.1.1 Affected Environment – Public Services

This section evaluates the effects of the Green Line on public services located near or providing services in the vicinity of the Green Line alternative alignments. Public services analyzed include police, firefighting, emergency medical response, public and private schools, U.S. Post Offices, and solid waste collection. Several federal government facilities are also noted in the Downtown Segment, the only segment with major federal facilities within close proximity of the alignment alternatives. More specifically, public services include:

- **Police.** The Seattle Police Department's north, west, and southwest precincts provide police services for the neighborhood segments that would be served by the Green Line. Table 4.9-1 lists precincts by location.
- **Port of Seattle.** In the Interbay and SODO Segments, the Green Line project would cross property controlled by the Port of Seattle, which provides its own police services in addition to services provided by the Seattle Police Department.
- **Fire.** The Seattle Fire Department has sixteen stations that serve the communities along the Green Line alternative alignments. Table 4.9-2 lists stations that provide fire protection and emergency medical services within the segments.
- **Hospitals.** Although there are no hospitals directly on any of the Green Line alternative alignments, emergency services are provided at nine hospitals in the project area, as listed in Table 4.9-3.
- **Schools.** Table 4.9-4 lists public and private schools along the Green Line alternative alignments. School buses also use streets (such as 15th Avenue NW, NW 75th Street, NW 65th Street, and California Avenue SW) that may be affected by the Green Line project.
- **Post Office.** There is one U.S. Post Office along the Green Line route in the Interbay Segment, at 2010 15th Avenue W. There are several U.S. Post Offices located one to three blocks from the Green Line alternative alignments in the Downtown and SODO Segments.
- **Solid Waste.** Rabanco Recycling, Inc. is located one block east of the Green Line south Operations Center alternative (at the southwest corner of S Lander Street and Utah Avenue S). Solid waste disposal and recycling trucks use the same surface streets proposed for location of Green Line guideway columns and stations.

Figures 4.9-1 through 4.9-5 identify service providers in the vicinity of the Green Line alternative alignments.

Table 4.9-1. Seattle Police Precincts Serving the Green Line Route

Segment	Station	Location
Ballard	North	10049 College Way N
Interbay, Queen Anne/Seattle Center/ Belltown, Downtown, SODO	West	810 Virginia Street
West Seattle	Southwest	2300 SW Webster

Table 4.9-2. Seattle Fire Department Stations Serving the Green Line Route

Segment	Station	Location	Equipment
Ballard	35	8729 15th Avenue NW	Engine 35
Ballard	21	7304 Greenwood Avenue N	Engine 21
Ballard	18	1521 NW Market Street	Engine 18, Hose 18, Medic 18 Ladder 8, Battalion 4
Interbay	23	Fishermen's Terminal	Engine 3 (Reserve Fireboat)
Interbay	8	110 Lee Street	Engine 8 and Ladder 6
Interbay	9	3829 Linden Avenue N	Engine 9 and Air 9
Interbay	20	3205 13th Avenue W	Engine 20
Interbay	41	2416 34th Avenue W	Engine 41
Downtown	2	2334 Fourth Avenue	Aid 2, Ladder 4, Engine 2, Safety 2
Downtown	10	301 Second Avenue S (department headquarters)	Aid 5, Ladder 1, Engine 10, Staff 10, Air 10, Deputy 1, and Hazardous Materials Unit
Downtown	5	925 Alaskan Way	Engine 4 (fireboat) and Engine 5
SODO	14	3224 Fourth Avenue S	S Ladder 7, Aid 14, Rescue 14
West Seattle	36	3600 23rd Avenue SW	Engine 36 and Marine Response
West Seattle	37	7300 35th Avenue SW	Engine 37
West Seattle	32	3715 SW Alaska Street	Medic 32, Ladder 11, Engine 32
West Seattle	29	2139 Ferry Avenue SW	Engine 29 and Battalion 7

Note: Some of the stations listed provide coverage beyond the project segment in which they are located.
Source: Seattle Fire Department (2003).

Table 4.9-3. Hospitals Serving the Green Line Route

Nearest Segment	Hospital	Location
Ballard	Swedish Medical Center/Ballard	5300 Tallman Avenue
Queen Anne/Seattle Center/Belltown	Group Health Medical Center	201 16th Avenue E
Downtown	Harborview Medical Center	325 Ninth Avenue
Downtown	Swedish Medical Center	747 Broadway
Downtown	Swedish Medical Center at Providence	500 17th Avenue
Downtown	Providence Health Systems	506 Second Avenue
Downtown	Virginia Mason	925 Seneca Street
Downtown	Regence Care & Clinical Options	1800 Ninth Avenue
SODO	Pacific Medical Center	1101 Madison

Table 4.9-4. Public and Private Schools within the Vicinity of the Green Line Alternative Alignments

Segment	School	Location
Ballard	North Beach Elementary	9018 24th Avenue NW
Ballard	Whitman Middle School	9201 15th Avenue NW
Ballard	Shine Bright Montessori	8015 15th Avenue NW
Ballard	Loyal Heights Elementary	2511 NW 80th Street
Ballard	Whittier K–5 Elementary	1320 NW 75th Street
Ballard	Salmon Bay K–8	1810 NW 65th Street
Ballard	Ballard 9–12 High School	15th Avenue NW/NW 65th Street
Ballard	Saint Alphonsus	5816 15th Avenue NW
Ballard	Seattle Maritime Academy	4455 Shilshole Avenue NW
Ballard	Pacific Crest	600 NW Bright Street
Interbay	Lawton Elementary	4000 27th Avenue W
Interbay	Seattle Country Day School	2619 Fourth Avenue N
Interbay	Coe Elementary	2424 Seventh Avenue W
Interbay	McClure Middle School	1915 First Avenue W
Interbay	John Hay Elementary	201 Garfield Street
Interbay	St. Anne	101 W Lee Street
Queen Anne/Seattle Center/Belltown	Center High School	Center House, Seattle Center
Downtown	Gatzert Elementary	1301 East Yesler Way
SODO	Beacon Hill Elementary	2025 14th Avenue S
West Seattle	West Seattle High School	3000 California Avenue SW
West Seattle	West Seattle Montessori	4536 38th Avenue SW
West Seattle	Seattle Lutheran	4141 41st Avenue SW
West Seattle	Hope Lutheran	4446 42nd Avenue SW
West Seattle	West Seattle Christian	4401 42nd Avenue SW
West Seattle	Holy Rosary School	4142 42nd Avenue SW
West Seattle	Pathfinder Elementary	5012 SW Genesee Street
West Seattle	Cooper Elementary School	1901 SW Genesee Street
West Seattle	Fairmount Park K–5	3800 SW Findlay Street
West Seattle	Gatewood K–5 Elementary	4320 SW Myrtle Street
West Seattle	High Point Elementary	6760 34th Avenue SW

Sources: Seattle School District Web Site (2003), Seattle Times School Guide (2003).

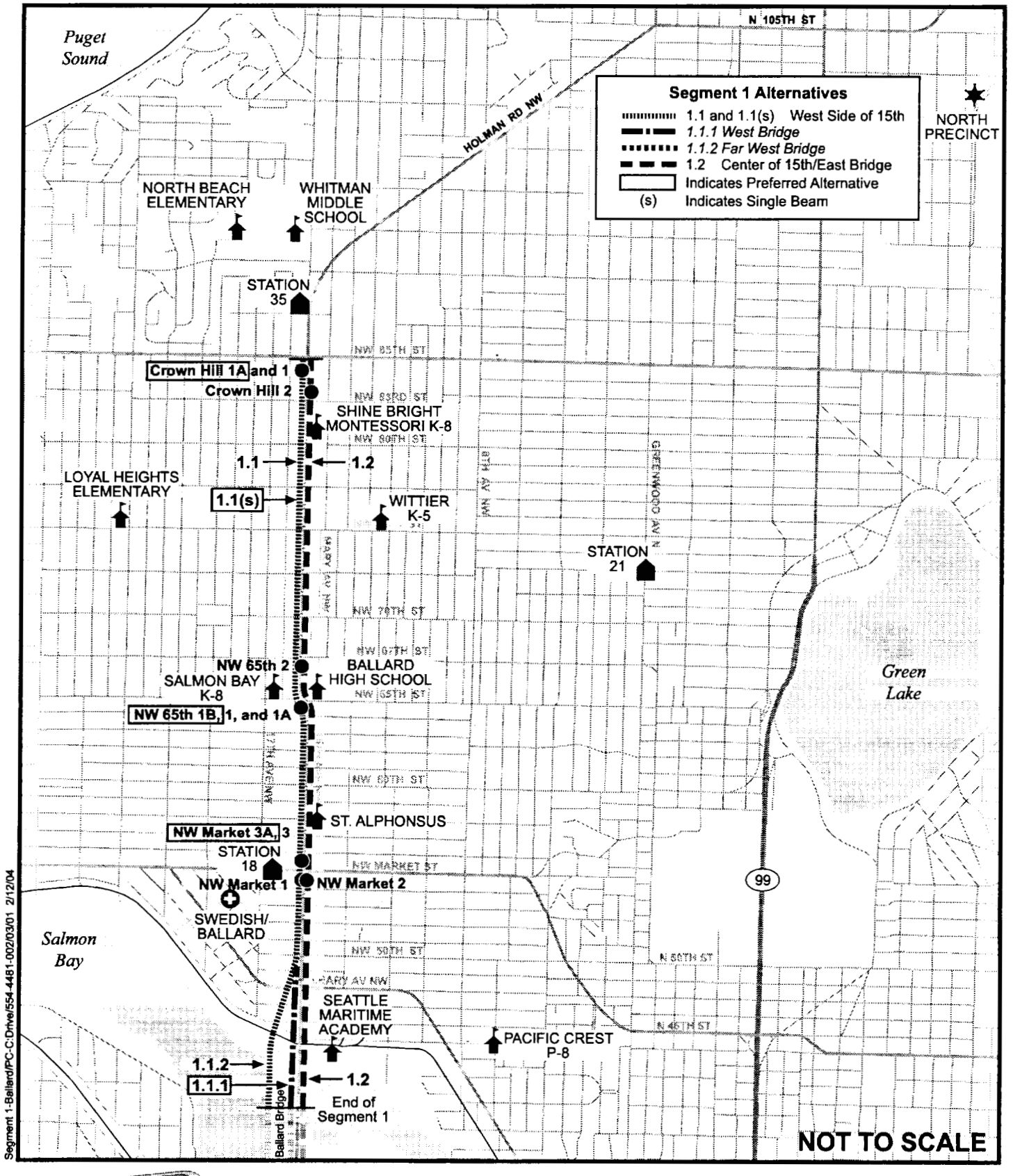
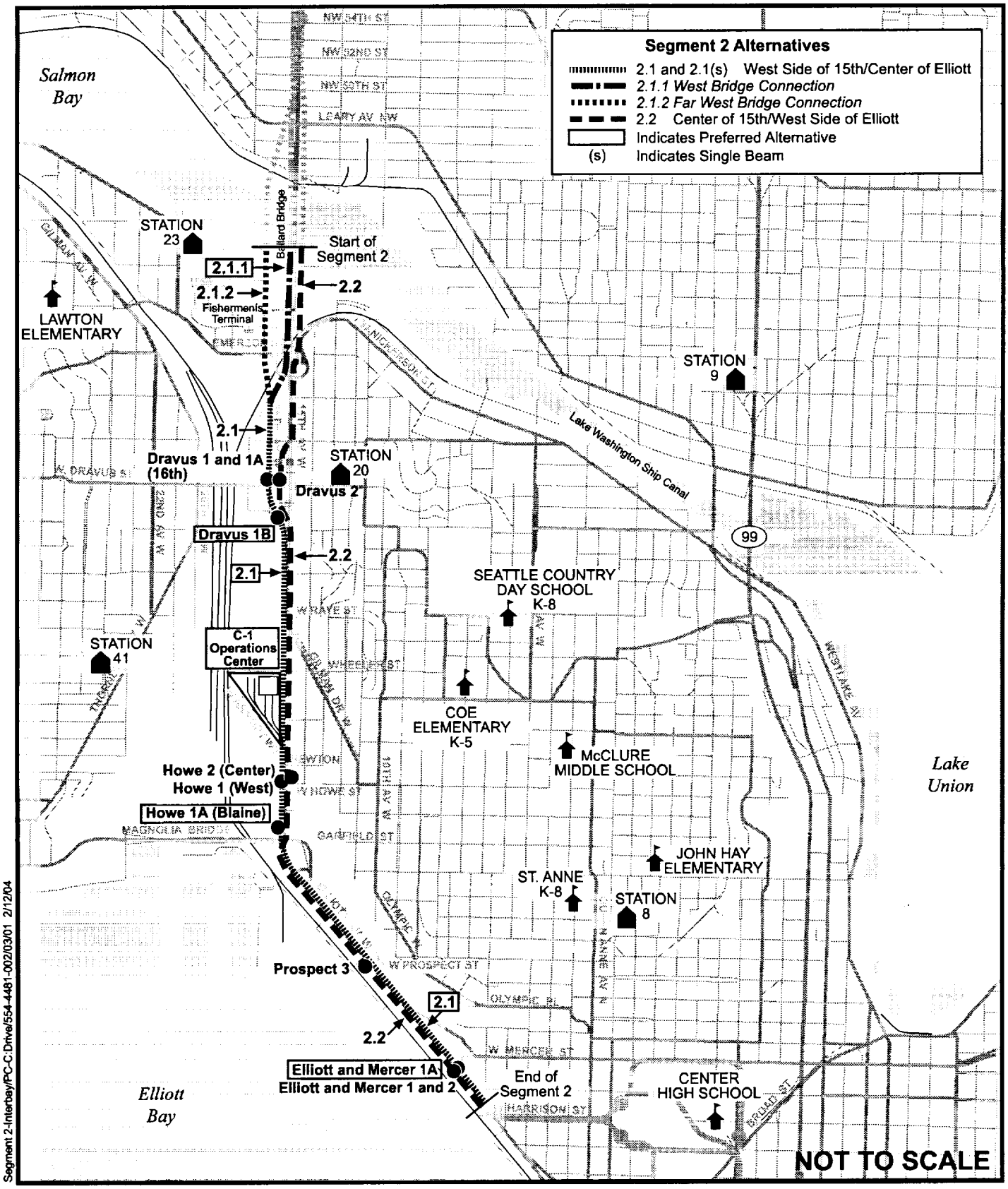


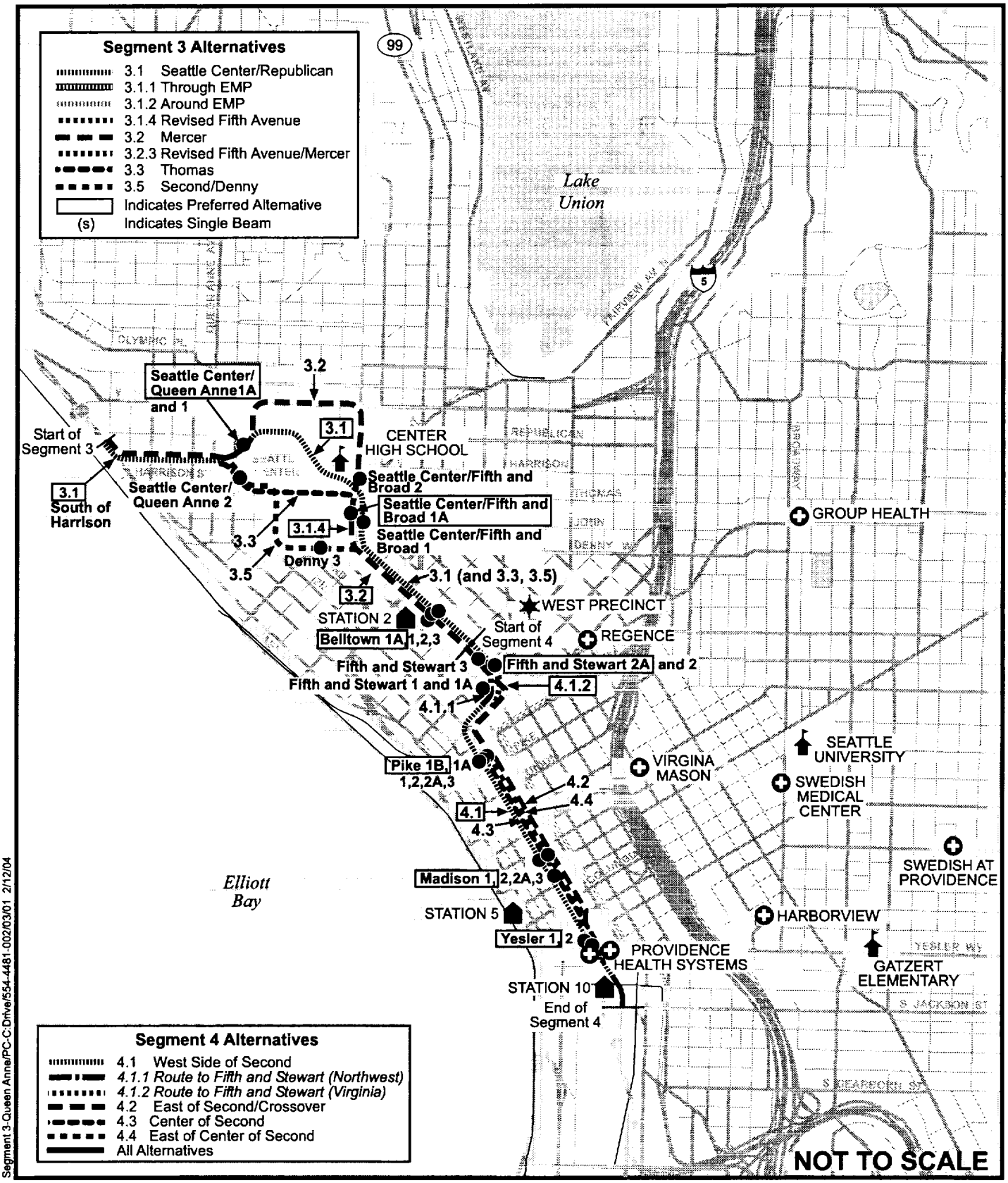
Figure 4.9-1
Segment 1: Ballard
Public Services



Segment 2-Interbay/PC-C:Drive/554-4481-002/03/01 2/12/04

SEATTLE MONORAIL PROJECT

Figure 4.9-2
Segment 2: Interbay/Magnolia
Public Services



SEATTLE MONORAIL PROJECT

Police
Firestations
Hospitals
Schools

N

Figure 4.9-3
Segments 3 and 4: Queen Anne/ Seattle Center/Belltown and Downtown/Pioneer Square Public Services

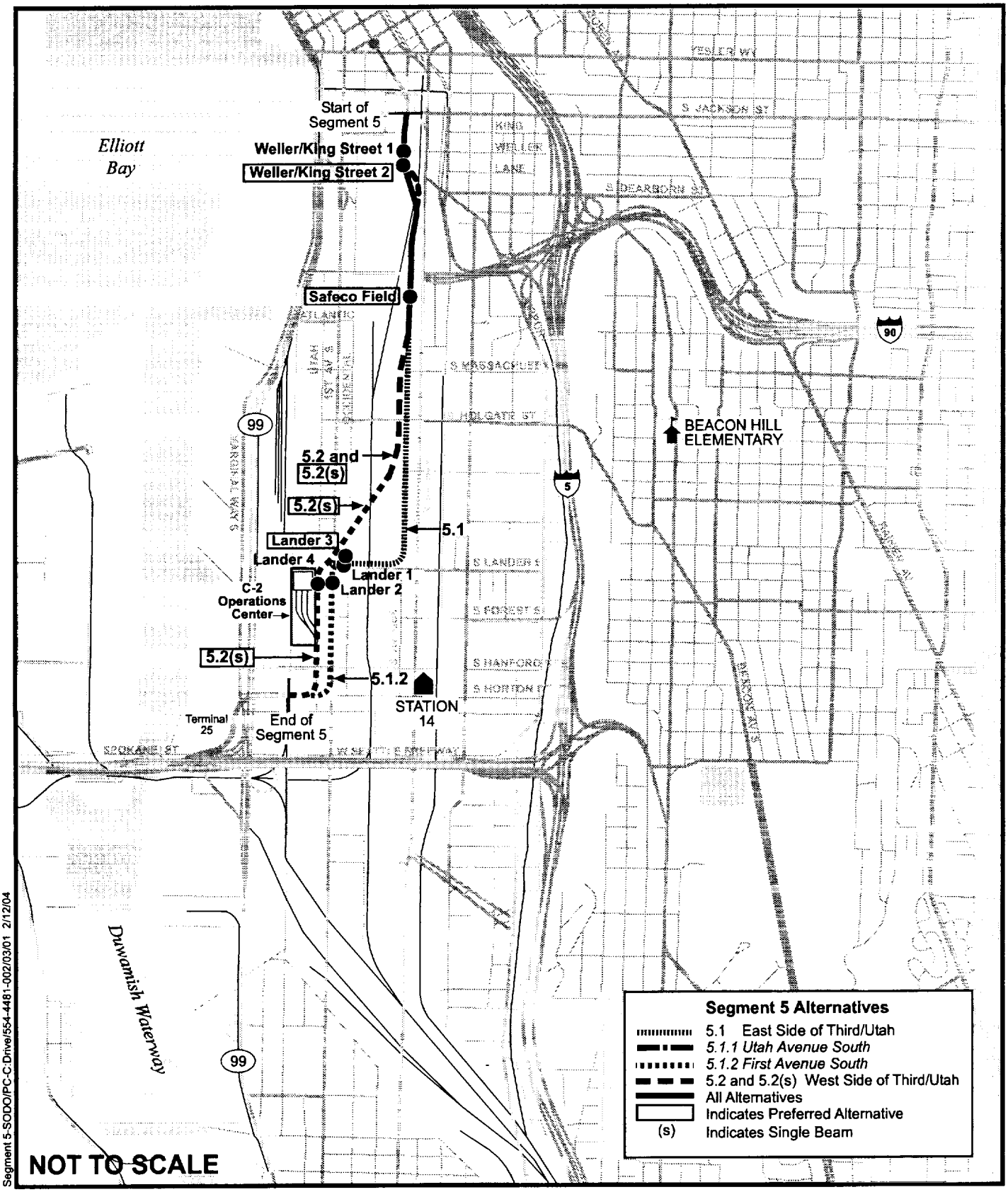


Figure 4.9-4
Segment 5: SODO/Chinatown International District/Pioneer Square Public Services

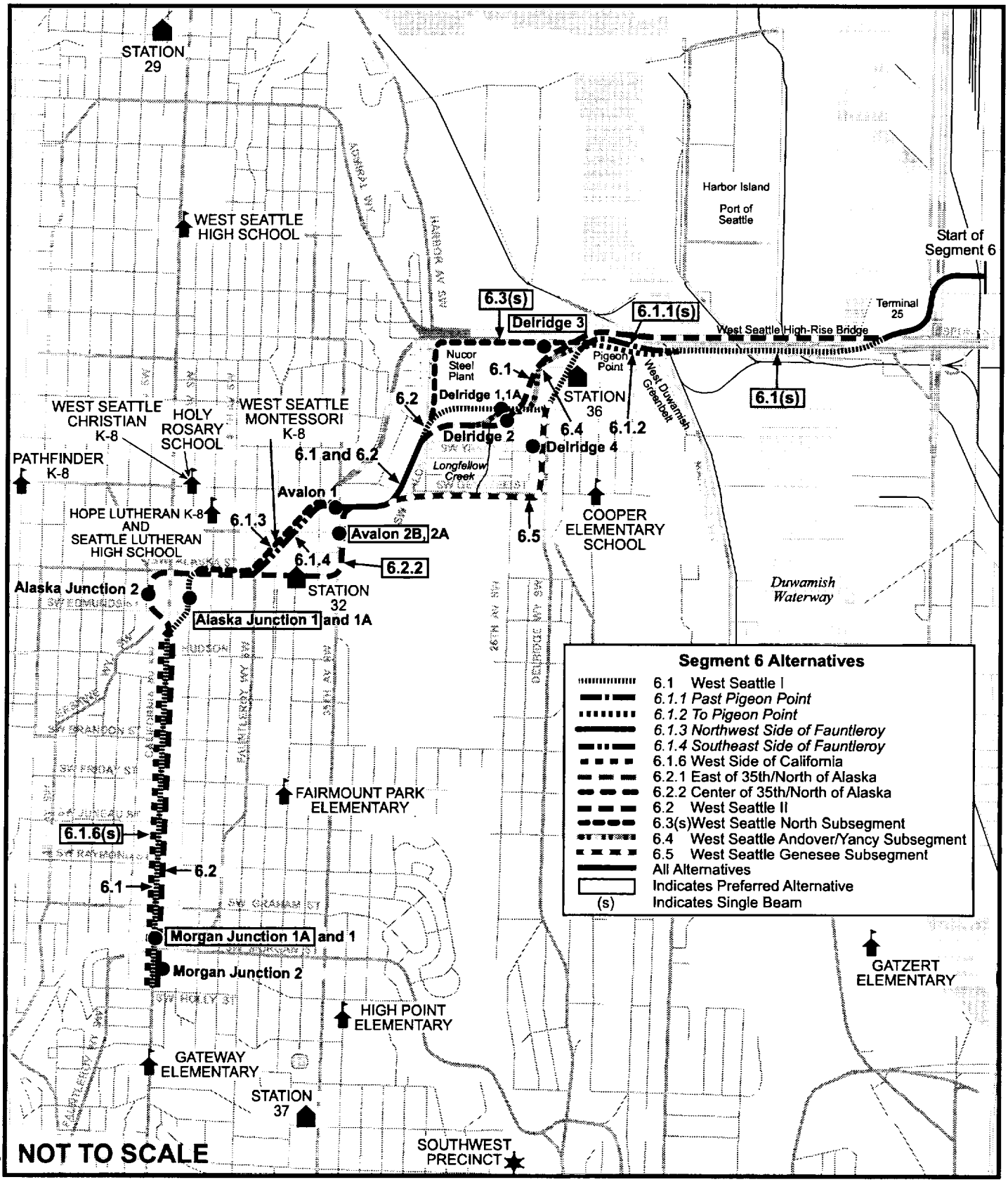


Figure 4.9-5
Segment 6: West Seattle Public Services

4.9.1.2 *Affected Environment – Utilities*

There are a number of utility providers along the Green Line alignment alternatives, including municipal agencies and private companies that provide electricity, water, wastewater and stormwater collection, natural gas, and telecommunications services. The construction and operation of the Green Line would be largely within public street rights-of-way, where utilities are generally located.

The existing utilities in the six segments are discussed in more detail in Section 4.17, Construction. However, major utility providers in the project area, which is entirely within the city of Seattle, are the same regardless of the segment. The major providers in the project area include:

- **Electrical Service.** Seattle City Light (City Light), a department of the City of Seattle, provides electric power to more than 345,000 customers in a 131.1-square-mile service area that includes Seattle and portions of King County. City Light owns nearly 1,900 megawatts of hydroelectric generation capacity and owns or contracts approximately 80 percent of its hydroelectric generating needs (City Light 2003a). A City-owned circuit of 657 miles of transmission lines carries power from the generating facilities to 14 major substations and 12 unit substations. City Light also owns and maintains a distribution circuit of 3,100 miles (City Light 2003b). In the study area, the City Light system uses a combination of electrical transmission and distribution lines. The transmission lines are typically 34 to 240 kilovolts (kV) arranged with a set of three conductors placed in-line (spaced 5.5 feet), while distribution lines range between 4 to 26 kV under the same configuration (BERGER/ABAM 2003a). Notable underground electrical duct banks (EDs) are located along the west side of Second Avenue. Overhead transmission lines are located crossing S Massachusetts and Third Avenue S, at the east approach to West Seattle Bridge, and at Utah Avenue S and S Hanford Street.
- **Water Supply.** Seattle Public Utilities (SPU) provides potable (drinkable) water to nearly 600,000 people in Seattle and surrounding areas. Two water sources, the 90,000-acre Cedar River Watershed and the 13,300-acre South Fork Tolt River Watershed, provide most of the service area's annual average consumption of 145 million gallons per day (SPU 2000). The system consists of transmission and distribution mains, fire hydrants, water meters, service lines, and water valve chambers. In the project area, the primary water mains range in size between eight and 20 inches and are typically located along the east side of north-south streets (BERGER/ABAM 2003a,c).
- **Sanitary Sewer and Stormwater.** SPU owns, operates, and maintains sewer collection facilities, including pipelines and other wastewater conveyance facilities, in Seattle. SPU inspects, repairs, operates, and maintains wastewater (sewer) pipes and pump stations in the project area to protect public health and avoid property and environmental damage from sanitary sewer overflows and combined sewer system overflows (SPU 2001). The King County Department of Natural Resources Wastewater Treatment Division provides sewage treatment services throughout the project area and also owns, operates, and maintains regional sewer conveyance pipelines. Wastewater in the project vicinity is conveyed to King County's West Point Treatment Plant, which operates at a capacity of 133 million gallons per day (King County 2003). Sewer mains in the project area range in size from eight to 24 inches, with a 30-inch line along SW Andover and a 36-inch line along the west side of Third Avenue. Other primary sewer mains in the project area are located along the center of 15th Avenue NW, west side of 15th Avenue W, center of Elliott Avenue, and the center of Utah Avenue S. Within the Downtown Segment, a 102-inch Metro combined sewer tunnel is located along the center of Second Avenue from Stewart Street to S Washington Street. The depth of this tunnel ranges from approximately

150 feet at Stewart Street to approximately 35 feet at S Washington Street (BERGER/ABAM 2003a,c).

Stormwater in Seattle is collected by storm sewers; a combined stormwater and wastewater system; or through a ditch, culvert, and creek system. SPU operates and maintains these drainage systems and also constructs new trunk lines and detention ponds to alleviate flooding problems. In the project area, the primary storm drains range in size between 8 and 21 inches and are located along the west side of 15th Avenue NW, west side and center of 15th Avenue W, west side of Elliott Avenue W, and the east side of Utah Avenue S (BERGER/ABAM 2003a,c).

- **Natural Gas.** Puget Sound Energy (PSE) provides natural gas service throughout the project area. PSE serves more than half of the residents of Washington State over a 6,000-square-mile service area. Their 620,000 natural gas customers are primarily in Western Washington (PSE 2003a,b). Natural gas pipes are located within the project vicinity in each segment. The primary high-pressure lines are located along Elliott Avenue W and 35th Avenue SW. Other major lines are located along 15th Avenue NW, 15th and 16th Avenues W, Elliott Avenue W, Utah Avenue S, Second and Third Avenues, SW Alaska Street, and SW Andover Street (BERGER/ABAM 2003a,c).

- **Steam.** Seattle Steam, a privately held company operating in agreement with the City, maintains 18 miles of piping in a one-square-mile area of Downtown Seattle. Steam distribution lines within the project area include a 12-inch intermediate pressure line traveling north and south along First Avenue. Steam is pumped through four main boilers with operating pressures of 140 pounds per square inch. Average production in the winter peak season is nearly 500,000 pounds of steam per hour, with a 100-pound-per-hour average in the summer (PSBJ 2001). Within the project area, the primary steam pipes range between eight and 12 inches in size (not including insulation) and are located along Stewart Street and Second Avenue (BERGER/ABAM 2003a,c).

- **Telecommunications/Fiber Optics.** Qwest provides local telephone service in the project vicinity and has fiber-optic lines in the project area. Several private companies and public utilities also own fiber-optic cable and/or provide long-distance and other telecommunication services in the general project area. Fiber-optic lines in the project area are primarily concentrated within the Queen Anne/Seattle Center/Belltown, Downtown, and SODO Segments. Many of the fiber-optic lines utilize deactivated gas pipes for conveyance. The City of Seattle Department of Information Technology (DoIT) also provides telecommunications, telephone, data network capability, and cable management services in the project area. DoIT provides a data network connecting all of the City's computers and departments together and connecting them to the Internet. DoIT also operates and maintains the City's private telephone network (about 12,000 telephones), voicemail, telephone management system, and the City's telecommunications (telephone and data networking) functions (Seattle, City of 2003a).

- **Traffic Signal Optimization Program**. Seattle Department of Transportation (SDOT) operates signals within the Green Line project area and within the Seattle city limits, including over 975 signalized intersections, three quarters of which are on major transportation corridors such as Aurora Avenue N, Delridge Way SW, Rainier Avenue S, and in the entire Downtown area (Seattle, City of 2003). The Signal Optimization Program is a coordinated effort designed to make the most efficient use of our city's traffic signals by improving signals, gathering up-to-date traffic data, and taking advantage of new technologies. Optimization refers to all maintenance, upgrades, timing adjustments, and other efforts to improve signalization (Seattle, City of 2003b).

- **Seattle Center.** The Seattle Center operates a public and private utility system that serves the 74-acre site, which is home to a variety of venues and facilities, including Pacific Northwest Ballet, Key Arena, Seattle Center Monorail, Space Needle, Experience Music Project, Memorial Stadium, Seattle Children's Theater, and others. The Seattle Center operates a combination of

utilities, including power, water, sewer, storm, natural gas, and steam. Telephone, fiber optic, and cable are also located in this area. Both Seattle Center and Qwest own and maintain underground telecommunications in this area, with major lines along Thomas Street, while SPU owns, operates, and maintains the water system serving this site. The 26 kV electrical distribution system that serves the campus is owned, operated, and maintained by Seattle City Light. The utility systems in the Seattle Center Segment are typical of the utilities found in the project area and include power, natural gas, water, sewer, stormwater, steam, and telecommunications/ fiber optic services.

4.9.2 Impacts

4.9.2.1 Long-Term System Impacts – Public Services

Impacts from operation of the Green Line on public services could involve either the physical placement of the project on or adjacent to a public service facility or a change in the operating environment of the public service. In some cases, the location of the project could also affect the level or type of services (such as police or emergency services) that may be provided. Some of the alternatives for Green Line stations, facilities, or guideway alignments could require the acquisition of publicly owned property, but overall acquisitions of such properties are low for all alternatives. Throughout most of the Green Line alignment, the same emergency service providers would respond to a call at any given station or alignment section regardless of the alternative. To the extent that differences among alignment and station alternatives result in different impacts, those impact differences are noted. Further, see Section 4.17-Construction for a discussion of construction impacts and mitigation.

The majority of the differences between alternatives involve location-specific changes in access to or by public services through the placement of Green Line routes or stations and through related roadway changes and transportation conditions. In most cases, the demand for services would be similar among alternatives and the analysis focuses on the relative change from No Action conditions.

In terms of access to public services along the Green Line, analysis indicates that access to some public services could be enhanced because of the Green Line. For example, there are schools within the vicinity of the proposed stations in the Ballard, Queen Anne/Seattle Center/Belltown, and West Seattle Segments of the Green Line project whose students could use the monorail for access. The Green Line could also result in an overall beneficial effect on access to public services by providing enhanced mobility.

Access by public services (specifically response times for some public services such as police, firefighting, and emergency medical aid) may be affected by placement of guideway columns. Impacts would be greater for center alignment alternatives for the guideway because left turn movements may be more difficult or may be prohibited at some intersections, mid-block or driveway access could be restricted to right-in/right-out movements, and because emergency vehicles often use a center left-turn lane as a through travel lane to avoid traffic congestion. Emergency services could be impacted if a monorail train gets stuck under or near to a Seattle City Light feeder that has only the minimum NESC safety clearance. If there is not enough clearance for emergency personnel to work safely, extra time would be required for Seattle City Light to de-energize and clear the lines, if possible. Specific recommendations for improving vehicle access and circulation in locations where guideway columns would be provided in an existing center two-way left turn lane are identified in the Transportation Mitigation section (Section 4.1.3). The SMP design team will coordinate with providers to determine the alternative with the least impact to emergency services routes during both construction and operation. In most locations along the project, parallel arterials may provide alternative routes if needed. The exception is in the Interbay Segment, where 15th Avenue W and Elliott Avenue W do not always have adjacent parallel routes. For these streets, center alignments would involve comparatively more

restrictions than alignments on the west side of the streets. However, provision for U-turns or provision of mountable curbs (so that emergency vehicles could drive over the median beneath the guideways, if necessary) would minimize potential delays or increases to response times (see Section 4.1.6 for additional information).

The potential impact of the Green Line on response times is difficult to quantify because response time is dependent on a large number of variable factors, such as time of day, degree of traffic congestion, types of uses in the neighborhood, extent of construction activity in the neighborhood, and how response time is calculated. Average citywide response times for the Seattle Fire Department fire, rescue, and hazardous material calls, for example, have varied from a low of 4.01 minutes in 1995 to a high of 4.24 minutes in 2002.

Delay of vehicles due to reduction in level of service (LOS) at intersections throughout the project has been analyzed and is discussed in Section 4.1, Transportation (for mitigation of these impacts on Green Line operations, see Section 4.1.3 and for mitigation of construction impacts, see Section 4.17 Construction). The Green Line may result in delay of emergency vehicles due to worsening LOS ratings at the following intersections:

- In the Ballard Segment, Alternatives 1.1, 1.1(s), and 1.2 may result in increased delays for intersections along 15th Avenue NW at NW Market, NW 65th, NW 80th, and NW 85th Streets. (Within this segment, the eastbound approach of the 15th Avenue NW and Holman Road NW intersection is already operating at an unacceptable LOS during the a.m. peak hour.)
- In the Interbay Segment, Alternatives 2.1, 2.1(s), and 2.2 may result in increased delays at W Dravus Street and 16th Avenue W, the 15th Avenue W ramp terminal intersections with W Dravus Street, and the Elliott Avenue W/W Mercer Place intersection.
- In the Queen Anne/Seattle Center/Belltown Segment, Alternative 3.5 (Second/Denny) may result in delays at Denny Way and Broad Street, particularly in the p.m. peak hour. Alternative 3.5 may also result in delays at Denny Way and Fifth Avenue during the a.m. peak hour.
- In the Downtown Segment, none of the Green Line alignment alternatives would significantly worsen intersection operation.
- In the SODO Segment, intersection LOS is expected to remain similar to the No Action conditions.
- In the West Seattle Segment, the Avalon 1 (Center) station alternative (Alternative 6.1) may result in delays at Fauntleroy Way SW and SW Avalon Way, as well as at 35th Avenue SW and SW Avalon Way.

A few of the alternatives may eliminate travel lanes, thereby reducing roadway capacity and potentially increasing emergency response times. Alternatives with streets that may be impacted due to loss of one or more travel lanes could include the following:

- Alternative 1.1 (West Side of 15th) or 1.1(s) (West Side of 15th single beam) in the Ballard Segment would eliminate one southbound and one northbound parking/peak travel lane currently open to traffic from 7:00 to 9:00 a.m. on 15th Avenue NW between NW 85th Street and NW 65th Street.
- Alternative 2.1 (West of 15th/Center of Elliott) or 2.1(s) (West of 15th/Center of Elliott single beam) would remove a southbound parking/peak travel lane on 15th Avenue W south of W Dravus Street. Alternative 2.2 (Center of 15th/West Side of Elliott) in the Interbay Segment would eliminate one southbound travel lane currently open to traffic from 7:00 to 9:00 a.m. on Elliott Avenue W between the Magnolia Bridge and W Morrison Street.

- Alternative 3.2 (Mercer) would eliminate one travel lane on Fifth Avenue. Alternative 3.5 (Second/Denny) in the Queen Anne/Seattle Center/Belltown Segment would eliminate one eastbound travel lane on Denny Way between Second Avenue and Fifth Avenue.
- In the Downtown Segment, all alternatives would eliminate one travel lane on Stewart Street.
- Alternative 5.1.2 (First Avenue S) in the SODO Segment would eliminate one southbound travel lane currently open to traffic from 4:00 to 6:00 p.m. on First Avenue S between S Lander Street and S Horton Street.

For center alignments, placement of monorail guideway columns would generally eliminate center two-way left turn lanes. This would result in reduced left-turn opportunities to and from unsignalized side streets. In locations where guideway columns would be placed in the center of one-way streets, vehicles could be prohibited from passing between columns to change lanes. These vehicular access restrictions could result in some out-of-direction travel for emergency vehicles, which could increase emergency response times. Emergency vehicles could also be affected because some of them currently use center left-turn lanes as through lanes to avoid traffic congestion and travel more quickly during emergency situations.

Placement of guideway columns could eliminate the center two-way left turn lane along the following streets:

- Alternative 1.2 (Center of 15th) in the Ballard Segment would eliminate the center turn lane on 15th Avenue NW, but would maintain northbound right-turn only lanes at NW 65,th NW 80th and NW 85th Streets
- Alternative 2.1 or 2.1(s) (West Side of 15th/Center of Elliott) in the Interbay Segment would eliminate the center turn lane on Elliott Avenue W. A new signal at W Lee Street would allow U-turn movements.
- Alternative 2.2 (Center of 15th/West Side of Elliott) in the Interbay Segment would eliminate the center turn lane on 15th Avenue W.
- Alternative 6.1 (West Seattle I) in the West Seattle Segment would eliminate the center turn lanes on SW Avalon Way and California Avenue SW.
- Alternative 6.2 (West Seattle II) in the West Seattle Segment would eliminate the center turn lanes on SW Avalon Way. Alternative 6.2.2 would eliminate the center turn lane along 35th Avenue SW.

One-way streets potentially affected by placement of guideway columns down the center of the street include:

- Alternatives 3.1 (Seattle Center/Republican), 3.3 (Thomas), and 3.5 (Second/Denny) in the Queen Anne/Seattle Center/Belltown Segment would place guideway columns down the center of Fifth Avenue through Belltown (in place of existing monorail columns).
- Alternative 4.3 (Center of Second) and 4.4 (East Center of Second) in the Downtown Segment would place guideway columns down the center of Second Avenue. (These columns would have special straddle foundations underground to avoid conflict with a major underground utility).

Regardless of the alignment alternative, planning to respond to emergencies on Green Line trains, at stations, or along the guideway could place new or different demands on emergency service providers. Emergency services could potentially be required for events such as a medical emergency, fire, or natural disaster at any of the stations, the Operations Center, or along the guideway. The Green Line would be

designed to provide a means of exiting a train in the event of an emergency stop and evacuation anywhere on the alignment, allowing passengers to reach a safe haven, either on the ground or at a nearby station. However, special procedures, training, or equipment may be required to address emergency access to trains on the guideway, particularly on the Ship Canal crossing in the Ballard Segment and on the Duwamish River crossing if a new, monorail-only bridge is constructed.

In terms of firefighter access to the monorail guideway and to adjacent buildings during an emergency, the Seattle Fire Department has indicated that (with exceptions in a few areas) ladders could reach over the guideway if needed (Conley 2003). However, it should be noted that ladders would be used to reach the guideway only as a last resort, and only after traction power has been disconnected. Additionally, the guideway itself could compromise firefighter's ability to fully access adjacent buildings with aerial ladders. In these instances, ground-based ladders would be used.

At the Federal Office Building on Second Avenue, Green Line guideways could potentially complicate surveillance and security measures due to reduced visibility from the street because of guideway and station supports and larger numbers of people moving around the entries to the building. Neither the guideway nor the stations in any segment are expected to adversely affect any U.S. Post Office.

Acquisition of public property would be required for some segments. For Alternative 1.2 (Center of 15th) in Ballard, a partial acquisition or air rights could be required from the Seattle Central Community College Maritime Training Center. However, it is expected that use of the property by the Maritime Training Center would not be affected. A portion of the property at Fire Station 36 in West Seattle would be acquired for placement of guideway columns for Alternative 6.1.2 (To Pigeon Point). Exact location of columns would be coordinated with Seattle Fire Department to avoid potential impacts. Similarly, Fire Station 32 could be affected by construction of a new, monorail-only bridge with Alternative 6.2 (West Seattle II). Station 32 has not been identified as a property acquisition need at this time, but SMP will coordinate with Seattle Fire Department on column placement to avoid impacts to services. A partial acquisition of the Department of Social and Health Services (DSHS) building parking lot and planting area at 4045 Delridge Way SW would be required for the Delridge 4 Station and alignment Alternative 6.5. Further discussion of the impacts to public properties can be found in Section 4.2, Displacements and Relocation.

In terms of Green Line operations and security at stations, SMP intends to hire security staff to patrol Green Line stations and trains and will develop a security plan for Green Line operations. In addition, incorporating principles of Crime Prevention Through Environmental Design (CPTED), such as strategic lighting, clear sightlines on the station platforms, and overall station site design, could enhance public safety at Green Line stations.

The Preferred Alternative evaluated in this Final EIS would include single-beam guideway operations in portions of the Ballard, SODO, and West Seattle segments. With the single-beam configuration, both northbound and southbound trains would operate on the same guideway requiring trains to pass each other at stations and dual-beam guideway segments. The Green Line system is in a class of technology called Automated Guideway Transit (AGT). These systems rely on technology to achieve safety goals and minimize the need for human action, and thus the risk of human error.

Safety issues will be addressed in a safety plan developed to identify, assess, and mitigate potential safety hazards. A hazards analysis that incorporates a rigorous process to identify all of the possible events that could result in an unsafe condition is a central component of the safety plan. The hazards analysis will identify portions of the operating system as being vital to system safety. These items must be designed, manufactured, and installed in accordance with the safety plan making failures resulting in unsafe conditions virtually impossible.

No public safety issues related to the single-beam guideway are anticipated, as the Green Line will have an automated control system (ATC) that monitors every train and its location at all times. Before a train is permitted to depart from a station, it must "request" a route to another position on the guideway (usually another station). Before the ATC system "permits" the train to move, it must establish the route and verify that (1) all switches on that route are properly aligned and locked, (2) no other trains occupy any portion of that route, (3) no other trains have routes that are in conflict, and (4) no other safety issues (such as guideway intrusions) exist. Historically, ATC systems have achieved safety performance levels that significantly exceed those of manually operated systems. The single-beam segments recommended as part of the Preferred Alternative would not introduce any decrease in the anticipated safety performance of the system compared to dual-beam segments. For more information on the operation of single-beam guideways and examination of existing single-beam systems, see the Single Beam Guideway Description included in Volume 2, Appendix LL of this Final EIS.

Preferred Alternative (Impact Summary)

In the Ballard Segment, the Preferred Alternative is a single beam configuration along the west side of 15th Avenue NW (Alternative 1.1(s)). Due to increased congestion and degraded LOS conditions, Alternative 1.1(s) may result in travel time delays for intersections along 15th Avenue NW at NW Market, NW 65th, NW 80th, and NW 85th Streets. Alternative 1.1(s) would also eliminate one southbound and one northbound off-peak parking/peak travel lane currently open to traffic from 7:00 to 9:00 a.m. on 15th Avenue NW between NW 85th Street and NW 65th Street. The elimination of one southbound and northbound off-peak parking/peak travel lane could result in response time impacts at this location, particularly during peak periods. Compared to the center of street alignment analyzed in Alternative 1.2, however, the Preferred Alternative would result in smaller travel time impacts and fewer restrictions for emergency providers.

In the Interbay Segment, the Preferred Alternative is a dual beam configuration along the west side of 16th Avenue W, the west side of 15th Avenue W, and the center of Elliott Avenue W with an Operations Center west of 15th Avenue W (Alternative 2.1). Due to increased congestion and degraded LOS conditions, Alternative 2.1 may result in travel time delays at W Dravus Street and 16th Avenue W, the 15th Avenue W ramp terminal intersections with W Dravus Street, and Elliott Avenue W and W Mercer Place. Alternative 2.1 would also remove a southbound parking/peak travel lane on 15th Avenue W south of Dravus and eliminate the center turn lane on Elliott Avenue W. The elimination of the center turn lane could result in response time impacts at these locations. In particular, the 15th Avenue W (south of Dravus) location would be affected during peak periods.

In the Queen Anne/Seattle Center/Belltown Segment, the Preferred Alternative would travel through Seattle Center along the path of Republican Street and then along the west side of Fifth Avenue through Belltown. The elimination of one travel lane on Fifth Avenue due to the guideway column placement could result in response time impacts. Compared to the alternative placing the guideway in the center of the street, however, the Preferred Alternative would have less impacts on response times.

In the Downtown Segment, the Preferred Alternative would travel west on Stewart Street and proceed south along the west side of Second Avenue (Alternative 4.1). It would eliminate one travel lane on Stewart Street, but would not significantly worsen intersection traffic operations, and would have the smallest impacts of any alternatives studied.

In the SODO Segment, the Preferred Alternative would travel in a diagonal alignment along the west side of Third Avenue S and Utah Avenue S. Intersection LOS conditions are expected to remain similar to the No Action LOS conditions.

In the West Seattle Segment, elimination of the center turn lanes on SW Avalon Way and 35th Avenue SW (between SW Avalon Way and SW Alaska Street) for the Preferred Alternative could result in response time impacts. The Preferred Alternative is anticipated to have relatively smaller impacts on California Avenue SW because it would not restrict movement in that corridor.

4.9.2.2 Long-Term System Impacts – Utilities

This section addresses impacts to utilities related to long-term operation of the Green Line. For construction impacts of utility relocation, please refer to Section 4.17, Construction. The Green Line system has the potential to cause direct and indirect impacts to utility services and infrastructure during operation. Longer-term operational impacts could include the potential for additional power infrastructure to serve the Green Line system, and potential conflicts with existing utility maintenance and replacement operations. See Section 4.17.10.2 for a discussion of utility relocation and utility impacts from construction of Green Line alternative alignments and stations.

This analysis of utility impacts focuses on utilities in close proximity to the Green Line alignment alternatives and provides a relative comparison of the level of impacts that could be expected for the different alignment and station alternatives. The basis for the utility analysis was the BERGER/ABAM overhead and underground utility relocation plans, tables, and cost estimates prepared for SMP, dated June 2003. This documentation is hereby incorporated by reference (BERGER/ABAM 2003a–f) (see Table 4.17-8 in the Construction section for a summary of this information).

Placement of guideway columns could complicate long-term maintenance of underground utilities when the guideway or other structures are in the immediate vicinity of the utility, although utility location will be one factor used to determine column placement. Guideway beams will typically span intersections to avoid cross-section utility impacts. Where foundations or guideway beams might limit access, these will be addressed on a case-by-case basis during final design. However, no significant adverse impacts to natural gas, telephone, telecommunications, water supply, wastewater, drainage, steam, or solid waste collection and disposal services would be expected during operation of the Green Line under any of the alternatives.

Underground gas, water, and sewer lines and other pipes and conduits beneath columns would not likely be affected by the weight of elevated segments because potentially affected utilities would be relocated or otherwise protected before or during construction. Concerns have been expressed that settling of elevated sections could affect underground utilities. However, it is unlikely that any settling would occur because the Green Line must have secure foundations, and foundations would be engineered to ensure that no settling occurs. Design and construction of foundation systems would not create loads or settlement of utilities or pipes.

As discussed in Section 4.8, Energy, the Green Line would be replacing fossil fuel sources for transportation, but would increase the electricity demand and consumption on the existing electrical system in the project area. Power demand for the Green Line operation would not significantly affect sources of electrical energy available to City Light, although upgrades to some transmission line and power substations may be required due to limited capacity of the existing distribution infrastructure. Section 4.8 includes a more detailed analysis of power supply and the Green Line's estimated power needs. Primary power would likely be provided to the monorail trains and stations from electrical feeds generated by either the Canal or Delridge substations.

Electrical power to the Green Line system could create the potential for stray current, which could accelerate the corrosion of underground utilities (i.e., buried metal pipes and conduits). Stray current is guideway power rail DC current that has found an alternate path (not through the power rails). Stray

current is eliminated through isolation of the power rails and possibly redundant power cabling. Stray current monitoring equipment is part of the guideway power system design and is located in the guideway power stations (SMP 2003c). In addition, design of the elevated guideway system and its structures would have lower potential for stray current compared to an at-grade or underground system, and the Green Line could incorporate cathodic protection devices within the structures and piers/foundations to further minimize the potential for stray current to be transmitted to underground utilities.

4.9.2.3 Impacts of No Action Alternative

No impacts on public services would occur under the No Action Alternative. However, access to schools (particularly Shine Bright Montessori, St. Alphonsus, and Ballard High School in the Ballard Segment and Center High School in the Queen Anne/Seattle Center/Belltown Segment) could be enhanced with the Green Line compared to the No Action Alternative.

No significant adverse impacts to Seattle utility services or infrastructure would occur under the No Action Alternative.

4.9.3 Mitigation

4.9.3.1 Mitigation of Long-Term Impacts – Public Services

Because the Green Line would be elevated, it is anticipated to have only minimal impacts to mobility along surface streets other than those specifically noted in Section 4.9.2.1. The Green Line could change access to or from public services, but effective transportation service and circulation could be maintained through provision of left turns at intersections and the ability to make u-turns or circular routes. Increases in emergency services response times could be further minimized through coordination of project design and emergency response route planning, and by the potential for medians to be designed to allow emergency vehicles to cross, or by the provision of u-turns at selected locations. The impact on response times for emergency vehicles could be partially mitigated through the use of intelligent traffic control technology as approved by the Seattle Fire Department and Seattle Department of Transportation. Analysis indicates that the Green Line may improve access to some public services such as to schools along the alignment.

In terms of impacts to public services resulting from increased demand caused by the Green Line itself, SMP intends to prepare a Safety and Security Plan for operations to minimize increased demand on public services. Monorail trains would be designed to minimize the possibility of accidental fire and include a minimal amount of combustible material. Emergency response time could be longer if a Green Line train becomes disabled under or near a Seattle City Light feeder line that has only the minimum NESC safety clearance. If there is not enough clearance for emergency personnel to work safely, extra time could be required for Seattle City Light to de-energize and clear the lines.

SMP also intends to incorporate principles of Crime Prevention Through Environmental Design into the design of stations and structures to maximize public safety at and around stations. Security personnel and closed-circuit television could be used to provide additional security at stations, particularly at the Ballard NW 65th, Seattle Center/Queen Anne, Weller Street, and Safeco Field stations during major events.

Additionally, SMP intends to participate in emergency and security planning with local, regional, and federal authorities to enhance preparedness for a wide range of potential risks, including natural disasters, accidents, and terrorist activities.

SMP is also part of a Fire and Life Safety Committee that includes the Seattle Fire Department, the Seattle Police Department, and other City of Seattle representatives. This standing committee would address fire and life safety issues throughout the project.

Emergency egress walkways may be installed along the guideway to provide for evacuation in the event of an emergency. The Fire and Life Safety Committee would review the design of the walkways, including access to and from train cars and stations. Special procedures may need to be developed and could be reviewed by the Fire Safety Committee and included in a safety and security plan to ensure the safety of firefighters and Green Line passengers in the event of a fire.

4.9.3.2 Mitigation of Long-Term Impacts – Utilities

Green Line operation is expected to cause minimal impacts to utilities over the long term based on the design aspects of the system, and in part, compliance with:

- City of Seattle and Washington State energy, building, fire, and other applicable code requirements for all design aspects of Green Line systems, stations, Operations Center, and guideways.
- Relevant operational utility policies and strategies listed in the adopted City of Seattle Comprehensive Plan, Utilities Element (level of service, conservation strategies, and coordination of service providers).

See Section 4.17.10.2 for a discussion of construction impact mitigation on Utilities.

4.9.4 Significant Unavoidable Adverse Impacts

The mitigation measures described above are expected to address any impacts on public services and utilities that could occur as a result of operation of the Green Line. Therefore, no significant unavoidable adverse impacts are expected.

4.10 PARKS AND RECREATION

4.10.1 Affected Environment

Seattle's parks and recreation system consists of open spaces, parks, boulevards, trails, beaches, lakes, and streams; recreational, cultural, environmental, and educational facilities; and a broad variety of programs. The diverse system is woven into the fabric of Seattle neighborhoods and contributes to the city's identity, stability, urban design, and network of public services. Citywide, the Seattle Parks and Recreation Department administers 400 parks and open space areas covering approximately 6,200 acres.

Although public park land may be used in this project, a Section 4 (f) analysis was not conducted because the regulations no longer apply to the Coast Guard. The Homeland Security Act of 2002 transferred the U. S. Coast Guard from the U. S. Department of Transportation (DOT) to the U. S. Department of Homeland Security (DHS). Prior to passage of the Homeland Security Act, the Coast Guard's bridge permit program had been a DOT program. As a DOT agency, the Coast Guard was responsible for implementing Section 4(f) of the DOT Act of 1966. The 1966 DOT Act requires DOT agencies to perform a particular type of alternatives analysis for transportation projects that use any land from a public park, recreation area, wildlife and waterfowl refuge, or any historic site. Since the Coast Guard is no longer a DOT agency, a Section 4(f) analysis is not required for Coast Guard bridge permit actions. The Coast Guard will, nevertheless, ensure project environmental impacts on these resources are identified and assessed in the EIS, and appropriately considered before any final agency action on the project is taken.

There are twenty existing and twelve planned parks and recreational facilities that are under the jurisdiction of City of Seattle Parks and Recreation Department and are within 600 feet of Green Line guideway alignment, station, and Operations Center alternatives (Seattle Parks and Recreation Department 2002). Tables 4.10-1 and 4.10-2 list existing and planned park and recreational resources, respectively, identified within the proximity of the Green Line project area. Existing parks are discussed in more detail in the following sections. The Seattle Center is not a City of Seattle park property and therefore it is not listed in these tables. Figure 4.10-1 shows the existing park and recreational resources.

Table 4.10-1. Existing Parks and Recreational Resources Within 600 Feet of the Green Line Alignment Alternatives

Segment	Park Resource
Ballard	Baker Park on Crown Hill
	Ballard Swimming Pool
	Greg's Garden (East Ballard P-Patch)
	14th Avenue NW Boat Ramp
Interbay/Magnolia	Interbay Athletic Complex
	Interbay P-Patch
	Southwest Queen Anne Greenbelt
	Kinnear Park
Queen Anne/Seattle Center/Belltown*	Tilikum Place
Downtown/Pioneer Square	Westlake Park
	Pioneer Square Park
	Occidental Square
SODO/Chinatown ID/Pioneer Square	Union Station Square

Table 4.10-1. Existing Parks and Recreational Resources Within 600 Feet of the Green Line Alignment Alternatives(continued)

West Seattle	West Duwamish and Pigeon Point Greenbelt
	Longfellow Creek Greenspace
	Delridge Playfield
	West Seattle Stadium Park
	West Seattle Golf Course
	Camp Long
	Fauntleroy Place
	Eddy Street Ravine

* Seattle Center is not a City of Seattle Parks and Recreation Department park, so it is not included in this list.
Source: *Seattle Park Guide*, Seattle Parks and Recreation (2001).

Table 4.10-2. Major Park Projects Planned Near the Green Line Alignment Alternatives

Segment	Planned Park Project	Implementation Status
Ballard	Development of the Ballard Municipal Center park at 5701 22nd Avenue NW in conjunction with the proposed Ballard Municipal Center development	Planning is scheduled in 2005–2008 funding cycle
	Development of Monroe Substation site at NW 65th Street and 15th Avenue NW into a small park, possibly a community garden	Seattle Parks expect to purchase property from Seattle City Light in 2004
	Extension of the Burke-Gilman Trail (the missing link) from Fremont through an alignment south of NW Market Street	Section from the Ballard Locks to NW 60th Street is scheduled for construction in 2003; design study has been completed for the "missing link" segment between 11th Avenue NW and the Ballard Locks
	Recently purchased pocket park site at southwest corner of NW 63rd Street and 17th Avenue NW	Property was purchased by Seattle Parks on March 17, 2003 and planning is underway
Interbay/Magnolia	No new parks are planned for the Interbay Segment at this time	
Queen Anne/ Seattle Center/ Belltown	Development of Belltown/Uptown waterfront connections to Myrtle Edwards Park	No schedule information is available
	Development of Ward Springs Park (Fourth Avenue N and Ward Street)	Park opened on June 1, 2002
Downtown/Pioneer Square	No new parks are planned for the Downtown Segment at this time	
SODO/Chinatown ID/Pioneer Square	No new parks are planned for the SODO Segment at this time	
West Seattle	Purchase of surplus utility property (California Substation) for park	Planning process scheduled to begin in September 2003
	Acquisition of Seattle City Light's Morgan Substation on Fauntleroy Way to develop a small park/plaza	Planning is scheduled in 2005–2008 funding cycle
	Purchase of land along Longfellow Creek and Puget Ridge for Delridge open space	Funding is available to build or improve trail segments in 2003–2004
	Walking trail development along Longfellow Creek Legacy Trail	Project ongoing, no schedule information is available
	Link between Alki Trail and Spokane Street Trail	No schedule information is available
	Planned "Junction Square" plaza on northwest corner of SW Alaska and 42nd Avenue SW	No schedule information is available

Source: ETC (2002).

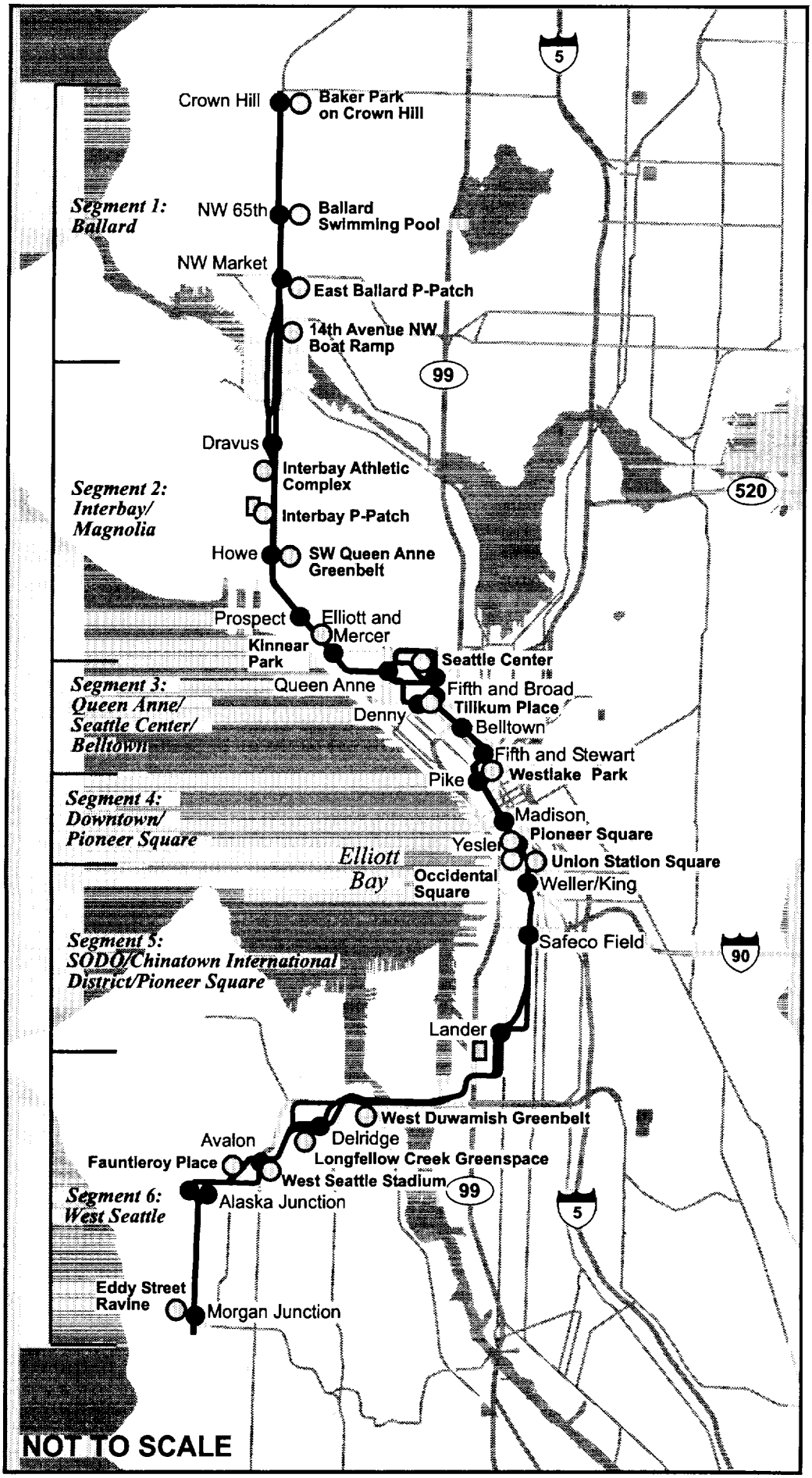


Figure 4.10-1
Locations of Parks, Recreational Resources, and P-Patches along the Green Line Corridor

- Parks, Recreational Resources, and P-Patches
- Station Vicinities
- Operations Center Alternatives

N

SEATTLE MONORAIL PROJECT

Corridor Project Area/PC-C.Drive/554-4481-002/03(01) 2/24/04

4.10.1.1 Segment 1: Ballard Segment

The Ballard Segment has four existing and four planned parks (Table 4.10-2) and recreational resources within 600 feet of the Green Line alignment alternatives. Existing parks and recreational resources include:

- **Baker Park on Crown Hill.** This 0.4-acre park includes a small play area, a pedestrian path, and a totem pole made from a monkey-puzzle tree. Baker Park spans the block between Mary Avenue NW and 14th Avenue NW, one lot south of NW 85th Street. Adjacent uses include residences and commercial properties.
- **Ballard Swimming Pool.** This is an indoor facility open for public use throughout the week. The pool is located on the east side of 15th Avenue NW immediately south of NW 67th Street and north of Ballard High School. There are tennis courts located at the site as well.
- **Greg's Garden.** This was formerly known as the East Ballard P-Patch. It covers 5,000 square feet is located on the southwest corner of 14th Avenue NW and NW 54th Street.
- **14th Avenue NW Boat Ramp.** The 0.64-acre boat ramp is located on the Lake Washington Ship Canal at the intersection of 14th Avenue NW and Shilshole Avenue NW, east of the Ballard Bridge. The site is one of Seattle's free-of-charge boat launch ramps, offering two piers and two launch lanes. The boat ramp was renovated in 1996, adding a new dock, a resurfaced ramp, and improved parking. The upland improvements include two handicap parking stalls and an accessible portable restroom.

4.10.1.2 Segment 2: Interbay/Magnolia Segment

The Interbay Segment has four existing parks and recreational resources within 600 feet of the Green Line alternative alignments. Existing parks and recreational resources include:

- **Interbay Athletic Complex.** The Interbay Athletic Complex includes the Soccer Center, the 39-acre, nine-hole Interbay Golf Center, and Little League baseball, softball, and T-ball facilities. It is west of 15th Avenue W between W Dravus and W Wheeler Streets.
- **Interbay P-Patch.** The 1.91-acre P-Patch is a year-round, community-operated garden located at the southeast end of the Interbay Athletic Complex, on 15th Avenue W just north of W Wheeler Street.
- **Southwest Queen Anne Greenbelt and Kinnear Park.** The approximately 15-acre Southwest Queen Anne Greenbelt and the two-tiered 14-acre Kinnear Park are located on the southwest slope of Queen Anne Hill above 15th Avenue W and Elliott Avenue W. The parks offer views of Elliott Bay and Downtown Seattle, walking paths, and wooded areas and grassy areas for sitting.

4.10.1.3 Segment 3: Queen Anne/Seattle Center/Belltown Segment

This segment has one existing park and two planned park improvements (Table 4.10-2) within 600 feet of the Green Line alternative alignments. The existing park is:

- **Tilikum Place.** This 0.1-acre park is located in Belltown at the "five points" intersection of Fifth Avenue, Denny Way, and Cedar Street, immediately west of the existing monorail. The park has the life-size statue of Chief Seattle made by James Wehn in 1912.

Seattle Center is a 74-acre recreational and cultural facility located between lower Queen Anne and Belltown. It is an important recreational and cultural resource for the city. However, since Seattle Center

is not a City of Seattle park, it is not discussed in this chapter, but, instead, is discussed extensively in Section 4.3, Land Use and Neighborhoods, and Section 4.5, Visual Quality and Aesthetic Resources.

4.10.1.4 Segment 4: Downtown/Pioneer Square Segment

The Downtown Segment contains three existing parks within 600 feet of the Green Line alternative alignments. There are no planned park projects.

- **Westlake Park.** Westlake Park is located in the heart of Seattle's retail district on Pike Street between Fourth and Fifth Avenues.
- **Pioneer Square Park.** Pioneer Square Park is located at First Avenue and Yesler Way in the Pioneer Square Historic District and contains the Pioneer Square Pergola.
- **Occidental Square.** Occidental Square is located at Occidental Avenue S and S Main Street in the heart of Pioneer Square and contains the Firefighter's Memorial.

The Garden of Remembrance at Benaroya Hall is not a city park, but is a public resource. It is discussed in Section 4.5, Visual Quality and Aesthetic Resources.

4.10.1.5 Segment 5: SODO/Chinatown International District/Pioneer Square Segment

The SODO Segment has one existing park resource. No park projects are planned for this area. Safeco Field and Seahawks Stadium are spectator sport recreation facilities that would be served by the Green Line, and are noted as such in Section 4.3, Land Use and Neighborhoods.

- **Union Station Square.** This triangular property is in the Pioneer Square District at S Jackson Street between Second and Third Avenues S. The park does not have active uses.

There are also two public parks on the Green Line that are under the Seattle Department of Transportation's jurisdiction: Fortson Square on the southeast corner of Yesler Way and Second Avenue S, and Washington Square on the southwest corner of S Jackson Street and Second Avenue Extension S.

4.10.1.6 Segment 6: West Seattle Segment

The West Seattle Segment has six existing parks, one city-owned open space area (Eddy Street Ravine), and six planned park improvements (Table 4.10-2) within 200 feet of the Green Line project area. Existing parks and recreational resources include:

- **West Duwamish and Pigeon Point Greenbelt.** A portion of the 181.6-acre West Duwamish Greenbelt is located within the West Seattle Segment and includes a steep slope area at Pigeon Point. The greenbelt is owned by the City of Seattle and is composed of steep, wooded slopes above the West Seattle Bridge and the east-facing slopes above W Marginal Way and the Duwamish River.
- **Longfellow Creek Greenspace.** Longfellow Creek originates in Roxhill Park to the south and flows north about four miles parallel to the Delridge Way SW corridor. The creek enters a pipe at SW Andover Street that carries the stream under the Nucor Steel property and discharges into the West Duwamish Waterway to the northeast. The Longfellow Creek watershed is approximately 2,685 acres, and the Longfellow Creek Greenspace is managed so as to preserve and protect the stream. The greenspace is largely undeveloped, although there are footpaths used by the public, including residents in the neighborhood. There has been a community effort to improve the stream for fish habitat for several years, including yearly fish releases conducted by local schools. A Longfellow Creek Dragonfly Pavilion is planned to be located adjacent to 28th Avenue SW

near SW Dakota Street in the upland area of the Longfellow Creek Greenspace. The plant and animal environment of Longfellow Creek is described in more detail in Section 4.15, Plants and Animals.

- **Delridge Playfield**. The 14-acre playfield contains grass picnic and play areas, tennis courts, a wading pool, a soccer field, and baseball fields. The Delridge Community Center is part of the park and offers a wide variety of classes and programs for all ages groups.
- **West Seattle Stadium Park.** This park has football and soccer fields and facilities for field sports (such as long jump, pole vault, shot put, and others), including a 400-meter track. The fields are used for youth, masters, and high school meets. Also on the site is a parking lot that serves the Stadium and the Golf Course.
- **West Seattle Golf Course.** This is a public 18-hole golf course.
- **Camp Long.** This 68-acre park has a nature center with meeting and recreational facilities for environmental education, forested trails and paths for hiking, cabins and picnic shelters, a climbing rock, and a pond.
- **Fauntleroy Place.** Fauntleroy Place is a triangular landscaped area (0.07-acre) at the junction of Fauntleroy Way SW, 38th Avenue SW, and SW Oregon Street. It is used primarily as a bus stop waiting area.
- **Eddy Street Ravine.** Eddy Street Ravine is a public street right-of-way and City-owned open space located west of California Avenue SW to 47th Avenue SW along the curve of SW Eddy Street. This ravine is one of the largest unimproved open spaces in the Morgan Junction area, with opportunities for trails, native habitat restoration, and interpretive signing.

4.10.2 Impacts

4.10.2.1 Long-Term Impacts

Direct long-term impacts from the Green Line could include view blockage, shadows, and access restrictions where parks or recreational resources are located adjacent to the monorail guideway or a station. Increased traffic or transit activity near a park or recreational resource could also cause changes in access, shadows, and views from parks. Shadow and view impacts are also discussed in Section 4.5, Visual Quality and Aesthetic Resources. Increased noise is not expected to be high, unless otherwise specified in the discussion below, due to the urban setting.

Operation of the Green Line could improve access to parks and recreational resources, especially for those who live or work within walking distance of a monorail station, which could increase park usage without increasing parking demand.

Potential long-term impacts on parks and recreational resources in each segment of the Green Line are discussed below.

Segment 1: Ballard Segment

Green Line station and alignment alternatives are expected to have low impacts on parks along the alignment in Ballard.

- **Baker Park on Crown Hill.** Views of the Green Line station and guideway Alternatives 1.1, 1.1(s), and 1.2 would be blocked by the Crown Hill Safeway at NW 85th Street and 15th Avenue NW. Project impacts to this park are expected to be low for all alignments and station alternatives.

- **Ballard Swimming Pool.** The NW 65th 2 (Center) station and Alternative 1.2 would have a moderate to high impact on the Ballard Swimming Pool because of the platform and access stairs on the east side of 15th Avenue NW, directly adjacent to the pool building. Impacts would include a change in visual character and possible removal of street trees. Shadow impacts on the building and parking lot would be low since the corner and west side of the building are now shaded by medium to very large trees. Access to the pool and the planned park at the Monroe Substation site could improve with the addition of the Green Line, which could increase use of the pool. Alternatives 1.1 and 1.1(s) and station alternatives NW 65th 1 (West), 1A (West), and 1B (West) would have no direct impact on the pool because they all would be located south of NW 65th Street. With any of these alternatives, there would be potential parking impacts. These would be expected to be greater with NW 65th 2 because of its close proximity. Impacts due to the Preferred Alternative are expected to be identical to Alternative 1.1(s).
- **Greg's Garden and 14th Avenue NW Boat Ramp.** Operational impacts on Greg's Garden and the 14th Avenue NW Boat Ramp are expected to be low to nonexistent for all three Ship Canal bridge alternatives (1.2, 1.1.1, 1.1.1(s), and 1.1.2) because the alternatives would be approximately 600, 1,000, 1,000, and 1,800 feet away from the 14th Avenue NW Boat Ramp, respectively, and 600 feet from Greg's Garden. Impacts on the planned extension of the Burke-Gilman Trail due to any of the alignment or station alternatives are expected to be low because the trail would be passing through an industrial corridor in this area.

Segment 2: Interbay/Magnolia Segment

Green Line station and alignment alternatives are expected to have low to moderate impacts on parks along the alignments in Interbay. Alignment Alternative 2.2, traveling along the west side of Elliott Avenue W, would be adjacent to the perimeter of the Interbay Athletic Complex and Interbay P-Patch. Golf course and P-Patch users in particular could experience changes to the visual or aesthetic setting and altered access due to the location of the guideway and columns. Alignment Alternatives 2.1 and 2.1(s) are expected to have less impact than Alternative 2.2 because Alternative 2.1 or 2.1(s) would be in the center of Elliott Avenue W, an additional 50 feet farther away. Access to these park and recreational areas may improve due to the increased transit service frequency with any of the alternatives, which may increase use of these park resources. Alternative 2.1(s) with a single beam configuration would result in somewhat reduced visual and shadow impacts.

The Preferred Alternative for Interbay (Alternative 2.1, on the west side of 15th and center of Elliott with the Interbay Operations Center alternative) would be the same as those described above for Alternative 2.1 and below for the Interbay Operations Center.

The Interbay Operations Center alternative is located on the Northwest Center site, immediately south of the Interbay P-Patch. Long-term noise, traffic, or visual impacts associated with this Operations Center alternative are expected to be low given the low-intensity nature of the uses and low number of personnel required at the Operations Center. There would be no operational impacts on the Southwest Queen Anne Greenbelt and Kinnear Park because of their locations above and east of 15th Avenue W.

Segment 3: Queen Anne/Seattle Center/Belltown Segment

Impacts on Tilikum Place under Alternatives 3.1, 3.3, or 3.5 would be lower than impacts associated with the No Action Alternative because of newer and quieter trains compared to the existing monorail. Green Line columns and guideway would also be less bulky and therefore less of a presence than the existing monorail. An increase in visual obstruction could be expected from Alternative 3.2 (Mercer) if the existing Seattle Center Monorail remains along with the Green Line. Impacts to Seattle Center are

discussed in Section 4.3, Land Use and Neighborhoods, and Section 4.5, Visual Quality and Aesthetic Resources. There would be no impacts on the planned parks.

Segment 4: Downtown/Pioneer Square Segment

Green Line alternatives are expected to have no or low impact on the Downtown parks.

- **Westlake Park.** The monorail guideway and stations at Stewart Street would not be visible from Westlake Park. If an elevated pedestrian connection from the Stewart station to Westlake Center is constructed, access to the park could be enhanced. The Fifth and Stewart 1 (Northwest) and 1A (West) station alternatives could provide slightly greater accessibility to Westlake Park than the Fifth and Stewart 2 (Virginia), 2A (Virginia Center), or Fifth and Stewart 3 (Lenora) stations, but otherwise the relationship of the park to the station alternatives would be similar.
- **Pioneer Square Park.** No direct impacts are anticipated, although the park could experience moderate vicinity impact. The alignment and Yesler station alternatives would be visible from Pioneer Square Park; however, Pioneer Square Park is a half block from the Yesler station alternatives. Traffic, noise, and activity levels in this park are not expected to increase significantly. Removal of the adjacent Sinking Ship parking garage and the development of a station facility on the site could enhance the park's surroundings and access to the park. Changes to the historic character of the area are discussed in more detail in Section 4.11, Cultural Resources.
- **Occidental Square.** The alternative alignments and stations at Yesler Way and S Weller Streets would be visible from the north half of the park. Traffic, noise, and activity levels in this park are not expected to increase significantly.

The Garden of Remembrance at Benaroya Hall is not a public park, but is a culturally important space. It would experience increased afternoon shading from Alternatives 4.2 (East Side of Second with Crossover) and 4.4 (East of Center of Second with Crossover). These two alternatives, more than 4.1 (West Side of Second) or 4.3 (Center of Second), would also alter the spatial quality of the memorial space by virtue of the overhead guideways. Inside the Garden, trees would screen the guideways. Noise levels would not increase noticeably above the ambient traffic levels.

Segment 5: SODO/Chinatown International District/Pioneer Square Segment

All of the alignment alternatives would be adjacent to Union Station Square and would introduce a new visual element to the park's surroundings. The guideways could cause some shadows and view blockages; however, overall noise and visual impacts are expected to be low since the park is currently surrounded by transportation uses.

Impacts to Fortson Square and Washington Square could result from a change in visual character and an increase in shading.

Segment 6: West Seattle Segment

Impacts to the parks in the West Seattle Segment would vary depending on the specific alignment alternative chosen. Impacts to most parks would be low to moderate; however, the Avalon 2A (35th) station alternative would be partially sited on park property, resulting in a high impact.

- **West Duwamish and Pigeon Point Greenbelt.** Impacts to the greenbelt would result from alignment Alternative 6.1.2 or 6.1.2(s) (to Pigeon Point) due to the placement of piers and other structural supports on steep slopes within Pigeon Point. Trees and other vegetation would likely

have to be removed or trimmed to keep the canopies away from the guideways. A discussion of the potential impacts to vegetation and habitat is provided in Section 4.15, Plants and Animals. There could be a low to moderate increase in shading under the guideways, depending on the slope and existing tree heights at specific locations.

The Preferred Alternative would have the lowest impacts because the alignment would continue along the West Seattle Bridge past Pigeon Point.

- **Longfellow Creek Greenspace.** Operation of several of the Green Line station and guideway alternatives would introduce additional visual elements for users of the Longfellow Creek Greenspace. Three Delridge station alternatives are located at the north end of the Longfellow Creek Greenspace, where the creek enters a culvert to pass under the Nucor Steel plant. . Station alternatives Delridge 1 (26th)/Alternative 6.1 and Delridge 2 (Andover)/Alternative 6.2, and alignment Alternative 6.1 (West Seattle I) could have columns in the buffer and culvert inflow area. Impacts for both station alternatives would include shading of the northeast corner of the buffer and could involve the removal of riparian vegetation and a few trees. Impacts could be higher for Delridge 1 (26th) if the property to the south of the station and SW Yancy Street is developed as a bus layover facility. The Delridge 1A (26th) station (Alternative 6.4) would have the lowest visual impacts of the three because the station would be located entirely in the parking lot east of the creek and the guideways would be well above the culvert at the north end of the buffer. The station would cast morning shadows on the buffer area. Diffuse shadows from the guideways would fall on SW Andover Way most of they year, except during the height of summer, when they could fall on part of the buffer.

  These station alternatives would also be near the possible future Dragonfly Pavilion, to be located near the curvilinear concrete retaining walls to the southwest. Views of the station and guideways from the interior of the park and the future Pavilion, if built, would be partially blocked by the buildings at the southeast corner of SW Yancy Street and 28th Avenue SW and by cottonwoods along SW Yancy Street. However, these additions to the park's surroundings may be perceived as negative impacts by park users. Other impacts that may be perceptible to park users are increased traffic or transit activity, and increased noise from buses and monorail trains.

  Alternative 6.5 (Genesee) would travel along the south side of SW Genesee Street. Longfellow Creek passes under SW Genesee Street at the northeast corner of the West Seattle Golf Course. As with Alternative 6.4, the guideways would be aligned over the street so shadow impacts would be low. The creek on the south side of SW Genesee Street would not be shaded, however the creek and greenspace on the north side would receive diffuse shading from autumn through spring.

  Alternative 6.4(s), a single beam configuration that would not include a Delridge station, would have lower impacts to the greenspace because there would be no station or associated bus layover space and because the single beam guideway configuration would cast narrower shadows.

  Alternative 6.3(s) (Delridge North) and associated station Delridge 3 (Nucor) would be located on the north side of the steel plant and would not impact the greenspace.

  The Preferred Alternative would not affect Longfellow Creek Greenspace because the alignment would travel north of the Nucor plant and use the Delridge 3 (Nucor) station alternative.

- **Delridge Playfield**. Alternative 6.5 (Genesee) subsegment would travel along the north side of the community center and playfield park. This would probably require the replacement of the street trees just south of the sidewalk on the south side of SW Genesee Street and would change the spatial quality of and views from the north end. The guideways would be quite high above

the street and would not block any views north to the neighborhood, and would remain in the street right-of-way outside park property.

The Preferred Alternative 6.3 (s) would not affect the playfields because the alignment would travel north of the Nucor plant.

- **West Seattle Stadium Park.** Alternative 6.2.1 would travel along the east side of 35th Avenue SW adjacent to the park. The Avalon 2A (35th) station alternative used by Alternative 6.2.1 would be located on park property, on the sloped, wooded area that is currently a mature tree buffer on the west side of a sports field (see Section 4.2, Displacements and Relocation). Impacts due to this station alternative would be high because most of the trees at the north end of the wooded buffer would be permanently removed (Figure M-101) and park property would be lost (please refer to Section 4.10.3, Mitigation, for a discussion of replacement property). This would affect views from and to the stadium site since the wooded hillside provides a backdrop to the field events inside the stadium.

  The Preferred Alternative 6.2.2 would have much lower impacts because it would not require park property. The Avalon 2B (35th) station would be on the west side of 35th Avenue SW; therefore there would be no impact on park property or the tree buffer. The tree buffer would remain and would screen views of the station and guideways from within the park. Selection of either the 2A or 2B station alternatives may improve access to the West Seattle Stadium, especially for those who live or work within walking distance of the monorail stations. Construction impacts to access are discussed in Section 4.17.11.1, Construction.

- **West Seattle Golf Course.** Alternative 6.5 (Genesee) would travel along the north side of the golf course, but impacts to the golf course would be low. The guideways are high enough to not block views to the north, and no shadows would fall on the golf course. Golfers now look at homes and midrise apartment buildings to the north of the course, and this view would be altered by the presence of the guideways.

- **Camp Long.** There would be no direct impacts because none of the alternatives would pass by the park.

- **Fauntleroy Place.** Impacts to Fauntleroy Place are expected to be low since the park is located adjacent to a high-volume arterial street (Fauntleroy Way SW). Alternative 6.1.3 (Northwest Side of Fauntleroy) is expected to have less impact than Alternative 6.1.4 (Southeast Side of Fauntleroy) since the Green Line alignment would be farther away from the park across Fauntleroy Way SW. Potential impacts due to either alternative include increased traffic or transit activity, alteration of the visual or aesthetic setting, and some shadow effects. Alternative 6.2 would not affect this park since the alignment would be located on 35th Avenue SW.

- **Eddy Street Ravine.** Impacts to the Eddy Street Ravine open space are expected to be low for either Alternative 6.1 or 6.2. However, impacts would be comparatively higher for Alternative 6.1 (or 6.1.6(s)) because the Morgan Junction 1 (West) station site is located just south of the Eddy Street right-of-way. Vehicular access to a short-term parking area and a small staff parking lot would be provided from the end of the Eddy Street right-of-way with Alternative 6.1 or 6.1.6(s).

4.10.2.2 Impacts of No Action Alternative

Adverse impacts on parks and recreational resources would not occur under the No Action Alternative. Access would remain unchanged and growth in resource use would continue, although possibly at a lower rate than with the Green Line project. To the extent that stations are planned near park resources such as

the Ballard Swimming Pool, Westlake Park, and West Seattle Stadium, then enhanced access to those resources would not occur with No Action.

4.10.3 Mitigation

Visual impacts as a result of the construction of alignment Alternative 6.1.2 to Pigeon Point and any alignment to the Longfellow Creek greenspace could potentially be mitigated by replanting in those locations after construction or by providing additional plantings at another location. Some visual impact to the Pigeon Point area from the 6.1.2 alignment alternative could be unavoidable due to the permanent removal of vegetation. During construction, temporary erosion and sediment control practices would be required and implemented. Preferred Alternative 6.1.1(s) would not affect the Pigeon Point greenbelt. Preferred Alternative 6.3(s) and its associated station would not affect Longfellow Creek greenspace.

Visual impacts to parks within sight of station alternatives such as West Seattle Stadium Park (Avalon 2A and 2B), Ballard Swimming Pool (NW 65th 2), Pioneer Square Park (Yesler 1 and 2), and Longfellow Creek Greenspace (Delridge 1, 1A, and 2) could be mitigated through appropriate design of facilities, including landscaping, special signage, lighting, and access. If the Avalon 2A (35th) station for Alternative 6.2 or 6.2.1 were selected, it would be designed to incorporate specific mitigation features for the park, including planting, access improvements, and design features to ensure that use of the stadium is not compromised. If this station alternative site were developed, City of Seattle Ordinance 118477 would require SMP to replace park property with other property in the same neighborhood that provided equivalent park functions. Preferred Alternative Avalon 2B would not affect West Seattle Stadium Park.

4.10.4 Significant Unavoidable Adverse Impacts

Construction and operation of a station at Longfellow Creek Greenspace would result in changes to the visual character and vegetation of the creek buffer at this location that could be perceived as a significant unavoidable adverse impact by park users. Mitigation could provide some improvement over existing conditions, including planting and access improvements. The Preferred Alternative would not affect the greenspace.

Similarly, construction of the guideway at Pigeon Point would result in changes to the visual character and vegetation of the greenbelt that could be perceived as an adverse impact by residents near the greenbelt. Mitigation would provide some revegetation and infill planting for the greenbelt. The Preferred Alternative would not affect the greenbelt.

Construction of the Avalon 2A (35th) station would result in the removal of the existing tree buffer along the northwest side of the West Seattle Stadium Park. Park users could perceive this as a significant adverse impact. Mitigation would provide some revegetation but the physical buffer would not be replaced. However, the property would be subject to the City of Seattle Ordinance 118477 requiring replacement of park property with other property, as discussed above. The Preferred Alternative would not affect West Seattle Stadium Park.